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Introduction

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WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

The following publications are abstracted in *STAR*:

Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A Washington, D. C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N. Y. 10017.

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The Preliminary Edition of the *NASA Thesaurus (December 1967)* (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus*, may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **2**

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Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **6**

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Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **27**

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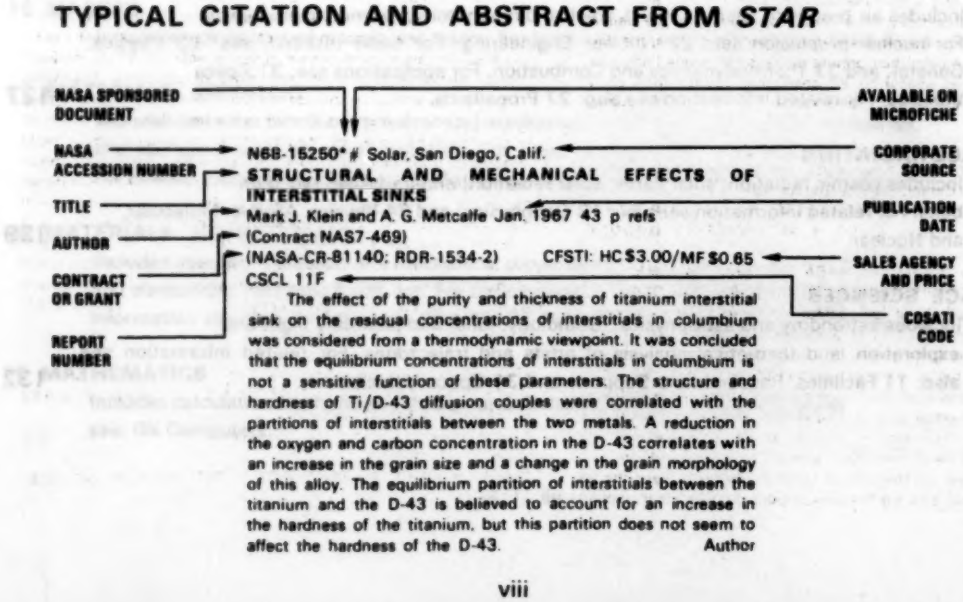
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N68-15250*# Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 6, NUMBER 1 / JANUARY 8, 1968

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N68-10060* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A MOVING-BELT GROUND PLANE FOR WIND-TUNNEL GROUND SIMULATION AND RESULTS FOR TWO JET-FLAP CONFIGURATIONS

Thomas R. Turner Washington NASA Nov. 1967 39 p refs
(NASA-TN-D-4228) CFSTI: $3.00 CSCL 14B

A moving-belt ground plane designed to eliminate the ground boundary layer for tests in ground proximity has been installed in a 17-foot (5.18-meter) wind-tunnel test section at the Langley Research Center. The test station was calibrated with this moving belt installed, and the effects of ground proximity on the characteristics of a swept and an unswept full-span blowing-flap configuration have been investigated. The results indicate that the moving belt satisfactorily removes the boundary layer on the ground plane. The lift loss of models at small distances from the ground and high lifts is considerably less with the belt moving at stream velocity (boundary layer removed) than with the belt at zero velocity. For configurations with full-span lift devices, the data indicate that the moving-belt ground plane is not needed for ratios of wing height (in spans) to lift coefficient greater than about 0.050, but is desirable for smaller ratios. Author

N68-10093*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION OF A 3/8-SCALE AUTOMOBILE MODEL OVER A MOVING-BELT GROUND PLANE

Thomas R. Turner Washington, NASA Nov. 1967 36 p refs
(NASA-TN-D-4229) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation of the effect of ground-plane boundary layer in wind-tunnel testing of a model automobile over a fixed ground plane has been made by using the endless moving-belt ground plane in the 17-foot test section of the Langley 300-MPH 7- by 10-foot tunnel. A 3/8-scale automobile model was tested with the ground-plane belt at free-stream velocity (i.e., with the boundary layer eliminated) as well as at a reduced velocity and zero velocity (i.e., with boundary layers). The results indicate that the boundary layer on the ground plane tends to increase the lift but has negligible effect on other components. The lift increment due to ground-plane boundary layer was smaller than that due to crosswinds or configuration changes such as a flush fairing on the underbody. Author

N68-10160* Scientific Translation Service, La Canada, Calif.

BOUNDARY LAYER EFFECT ON FLAT PANEL FLUTTER AT LOW SUPERSONIC SPEEDS [INFLUENCE DE LA COUCHE LIMITE SUR LE FLOTTEMENT D'UN PANNEAU PLAN EN SUPERSONIQUE FAIBLE]

Rolland Dat Washington NASA Nov. 1967 34 p refs Transl. into ENGLISH from Office Natl. d'Etude et de Rech. Aerospatiales, Tech. Note no. 116, 1967 37 p Presented at 25th Reunion of the Struct. and Mater. Group of AGARD, Ottawa, 24–29 Sep. 1967
(Contract NASw-1496)
(NASA-TT-F-11355) CSCL 01A

A simplified mathematical model of rectangular panel flutter has been developed. The real parts of the generalized aerodynamic forces are replaced by stationary, experimental ones. Author

N68-10203# RAND Corp., Santa Monica, Calif.

HYPERSONIC VISCOUS INTERACTION ON A SLENDER BODY OF REVOLUTION WITH SURFACE MASS TRANSFER

T. Y. Li and J. F. Gross Sep. 1967 50 p refs
(Contract DA-HC-15-67-C-0141; ARPA Order 189-1)
(RM-4491-ARPA; AD-659299)

An analytical formulation is presented of the problem of hypersonic viscous interaction on a very slender body of revolution with a thick boundary layer and mass transfer. Particular attention is directed to the establishment of the mathematical restrictions necessary to ensure the existence of similar solutions of the laminary boundary-layer equations for this class of problems. Yasuharas analysis is extended to include surface mass transfer and binary mixture effects. It is shown that when the boundary-layer thickness is of the same order of magnitude as the characteristic body dimension, rigorous similarity is possible only for three-quarter-power-law bodies. This is in agreement with Yasuharas earlier conclusions. Similar solutions to the boundary-layer growth equations exist when the transverse curvature expression is a function of the similarity variable. The criterion for the existence of similar solutions for the problem of hypersonic viscous interaction is that there must be a definite relationship between body surface shape and surface injection velocity. Author (TAB)

N68-10221*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EXPERIMENTAL INVESTIGATIONS OF WEDGE BASE PRESSURE AND LIP SHOCK

Francis R. Hama 1 Dec. 1966 55 p refs
(Contract NAS7-100)
(NASA-CR-90130; JPL-TR-32-1033) CFSTI: HC $3.00/MF $0.65
CSCL 01A

Base-pressure and surface-pressure measurements together with schlieren and shadowgraph observations were conducted on 6-deg half-angle wedges of various separation-edge shapes. The lip shock, which emanates from even a sharp separation edge, was found to be of substantial strength, contrary to the prevailing belief. In most cases investigated here, predominant cause of the lip shock appears to be the viscous separation effect similar to that of the separation shock emanating from a circular cylinder, rather than the inviscid rotational effect. Author

N68-10380* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FREE-FLIGHT AERODYNAMIC CHARACTERISTICS OF A SLENDER CONE BETWEEN MACH NUMBERS OF 7 AND 8
Joseph H. Judd Washington NASA Nov. 1967 42 p refs
(NASA-TN-D-4245) CSCL 01A

A free-flight test of a 3.56° half-angle cone configuration was made by use of the rocket test technique. The cone model was accelerated to a Mach number of 8 and a Reynolds number based on nominal body length of 25×10^6. Data are presented during the decelerating flight to a Mach number of 7 and a Reynolds number based on body length of 2.5×10^6 as the slowly spinning cone was disturbed in pitch by pulse rockets. The cone model demonstrated a good aerodynamic efficiency, having a lift–drag ratio of 2.77 at a Mach number of 7.3 and at an angle of incidence of 9°. During the decelerating flight a relatively steady value of the roll resonance parameter, approximately 0.8, was maintained. The measured variation of axial-force coefficient with resultant-force coefficient in the transverse plane agreed with estimated values obtained by using Newtonian theory and classical hypersonic similarity, although the estimated values obtained by using similarity were slightly lower. Author

N68-10529*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF SIMILARITY PARAMETERS FOR EXAMINATION OF GEOMETRY CHARACTERISTICS OF HIGH-EXPANSION-RATIO AXIAL-FLOW TURBINES
Arthur J. Glassman and Warner L. Stewart Washington NASA Nov. 1967 35 p refs
(NASA-TN-D-4248) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The similarity parameters are discussed with respect to turbine stage and overall characteristics. Interrelations among the number of stages, the stage diameter variation, the turbine expansion ratio, and the stage-similarity-parameter variation are explored. The highest overall efficiency in a multistage turbine is attained when the stage similarity parameters are maintained approximately constant near the stage optimum values. A turbine with a constant mean diameter cannot meet this requirement, especially for a high-expansion-ratio application. Appropriate proportioning of stage work and stage diameter as a function of stage-exit volume flow is used to estimate geometry characteristics for a constant stage-parameter design. More stages are required for the constant stage-parameter design than for the constant mean-diameter design. For the high-expansion-ratio cases, the rate of increase of stage diameter may become so severe as to exceed practical limitations. A limit imposed on the stagewise increase in diameter resulted in a reduction in the overall diameter variation but in a further increase in the number of stages. The turbine geometry characteristics were obtained for a nuclear rocket, a mercury Rankine cycle, and alkali-metal Rankine cycle applications. Author

N68-10814 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
TURBULENT BOUNDARY LAYER DISPLACEMENT EFFECTS IN HYPERSONIC FLOW
R. M. Grabow May 1967 97 p refs
(VKI-TN-34)

An approximate integral method is employed for the solution of turbulent boundary layer displacement effects in hypersonic flow. The method is applicable to axi-symmetric and two-dimensional bodies having an attached bow shock wave. The analysis includes the effects of arbitrary pressure gradients, heat, and mass transfer. For cones and wedges, closed form solutions of the displacement effects are obtained. For complex configurations, the solution involves the simultaneous integration of the momentum-integral equation, the moment-of-momentum equation, and the Prandtl-Meyer equations. Numerical results of the integral method are offered for both wind-tunnel and reentry flight conditions. Author

N68-10954*# General Dynamics/Convair, San Diego, Calif. Space Sciences Lab.
BASE FLOW FIELD INVESTIGATION ON THE S-II STAGE
L. D'Attorre and H. U. Thommen Mar. 1967 42 p refs
(Contract NAS8-21039)
(NASA-CR-90100; GDC-DBE-67-013) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The computer program for the calculation of the three dimensional interaction region of multi jet configurations by a finite difference method is re-examined in an attempt to reduce the number of parameters to be judged by the users. In conjunction a new finite difference method is introduced, which automatically provides an amount of dissipation appropriate to the requirements of the local flow conditions. In order to test the effectiveness of the additional dissipation mechanism a number of experiments were performed. As a consequence of those studies a simplified program is obtained and when applied to the calculation of five jet interactions, yields results which are at least of equal quality of those previously reported. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-10020 Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
NOISE EXPOSURE FORECAST AREAS FOR JOHN F. KENNEDY AIRPORT, NEW YORK, 1965, 1970 AND 1975 Final Report
Dwight E. Bishop and Richard D. Horonjeff Aug. 1967 23 p refs
(Contract FA-67-WA-1705)
(FAA-DS-67-11)

Noise Exposure Forecast (NEF) areas resulting from takeoff and landing operations at John F. Kennedy Airport, New York, are shown for 1965, 1970, and 1975. The NEF areas depict areas of differeing land-use compatibility with respect to aircraft noise; hence, the NEF areas may be used as a guide to land-use planning or zoning. The NEF areas are based upon aircraft noise described in terms of effective perceived noise levels, plus consideration of the number of operations per daytime and nighttime period. NEF areas B and C show sizable increases between 1965 and 1970. Between 1970 and 1975, a very moderate increase in NEF areas B and C is forecast. Author

N68-10021 Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
NOISE EXPOSURE FORECAST AREAS FOR CHICAGO O'HARE INTERNATIONAL AIRPORT, 1965, 1970 AND 1975

Dwight E. Bishop and Richard D. Horonjeff Aug. 1967 23 p refs
(Contract FA-67-WA-1705)
(FAA-DS-67-12)

Noise Exposure Forecast (NEF) areas resulting from takeoff and landing operations at Chicago O'Hare International Airport are shown for 1965, 1970 and 1975. The NEF areas depict areas of differing land-use compatibility with respect to aircraft noise; hence, the NEF areas may be used as a guide to land-use planning or zoning. The NEF areas are based upon aircraft noise described in terms of the effective perceived noise levels, plus consideration of the number of operations per daytime and nighttime period. NEF areas B and C show sizable increases between 1965 and 1970, particularly in northeast and southwest directions. Between 1970 and 1975, further moderate increases in NEF areas B and C are forecast. Author

N68-10027 Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
PROCEDURES FOR DEVELOPING NOISE EXPOSURE FORECAST AREAS FOR AIRCRAFT FLIGHT OPERATIONS Final Report
Dwight E. Bishop and Richard D. Horonjeff Aug. 1967 68 p refs
(Contract FA-67-WA-1705)
(BBN-1511; FAA-DS-67-10)

The NEF areas have differing land-use compatibility with respect to aircraft noise; hence, the NEF areas may be used as a guide to land-use planning and zoning. The NEF areas are based upon the aircraft noise described in terms of the effective perceived noise levels (which includes corrections for duration and presence of discrete frequencies) plus adjustments for the number of operations for daytime and nighttime periods. Noise and takeoff and landing profile information is given for estimating effective perceived noise levels for the takeoff and landings of current large jet aircraft and for future large aircraft expected to be in operation within the forecast periods. Computer-aided procedures employed in determining NEF contours are also outlined. Author

N68-10047*# Honeywell, Inc., Minneapolis, Minn.
DEVELOPMENT AND FLIGHT TESTING OF A FLUIDIC CONTROL SYSTEM
D. L. Rodgers Washington NASA Oct. 1967 146 p
(Contract NAS4-763)
(NASA-CR-913; Rept.-20175-FR2) CFSTI: HC $3.00/MF $0.65 CSCL 01D

A three-axis fluidic automatic flight control system was developed, installed, and flight tested in an Aero Commander 680 FP aircraft. The results of the analytical studies, system design work, and flight testing are presented in this report Author

N68-10088# Society of Automotive Engineers, Inc., New York.
TECHNIQUE FOR DEVELOPING NOISE EXPOSURE FORECASTS. NOISE EXPOSURE FORECASTS FOR J. F. KENNEDY INTERNATIONAL AIRPORT
Aug. 1967 9 p
(Contract FA-67-WA-1706)
(FAA-DS-67-15)

Tables containing computed noise exposure contours and flight path data are presented along with an overview map of Kennedy International Airport and its surrounding communities. The contours are based on airport operations data, aircraft performance, and aircraft gross weight distributions. E.C.

N68-10089 Society of Automotive Engineers, Inc., New York. Research Project Committee.
TECHNIQUE FOR DEVELOPING NOISE EXPOSURE FORECASTS Final Report
Aug. 1967 84 p refs
(Contract FA-67-WA-1706)
(FAA-DS-67-14)

A methodology called Noise Exposure Forecasts (NEF) is developed for describing aircraft noise exposure in the vicinity of the takeoff and approach flight paths of an airport. In support of this methodology an improved measure of the subjective response to aircraft flyover noise has been derived. This measure includes corrections for pure tone components and duration. Other elements necessary for the calculation of NEF are number of exposures and time of day. NEF contours are translated into guidelines for compatible land use. Author

N68-10236* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
COMPARISON OF FULL-SCALE LIFT AND DRAG CHARACTERISTICS OF THE X-15 AIRPLANE WITH WIND-TUNNEL RESULTS AND THEORY
Edward J. Hopkins (NASA. Ames Res. Center), David E. Fetterman, Jr. (NASA. Langley Res. Center), and Edwin J. Saltzman Washington NASA Mar. 1962 18 p refs Presented at the Conf. on the Progr. of the X-15 Proj., Edwards AFB, Calif., 20–21 Nov. 1961
(NASA-TM-X-713) CFSTI: $3.00 CSCL 01C

A comparison is made between the minimum drag of the X-15 as measured in flight and the minimum drag of an X-15 wind tunnel model extrapolated to flight Reynolds numbers. In addition, the trimmed lift and characteristics of drag due to lift obtained from wind tunnel model tests are shown to be in agreement with full-scale results for Mach numbers up to about 5. Existing theoretical methods are indicated to be adequate for estimating the X-15 minimum drag but underestimated the drag due to lift and overestimated the maximum lift-drag ratio. Two-dimensional theory is shown to be adequate for predicting the base pressures behind surfaces having very blunt trailing edges, such as those on the vertical tail of the X-15. Author

N68-10265# Society of Automotive Engineers, Inc., New York. Research Project Committee.
TECHNIQUE FOR DEVELOPING NOISE EXPOSURE FORECASTS. NOISE EXPOSURE FORECASTS FOR LOS ANGELES INTERNATIONAL AIRPORT
Aug. 1967 18 p ref
(Contract FA-67-WA-1706)
(FAA-DS-67-17)

Contour maps of noise exposure forecast for the Los Angeles International Airport and tabulated input data on which they are based are presented and explained. R.N.A.

N68-10266 Society of Automotive Engineers, Inc., New York. Research Project Committee.
TECHNIQUE FOR DEVELOPING NOISE EXPOSURE FORECASTS. NOISE EXPOSURE FORECASTS FOR O'HARE INTERNATIONAL AIRPORT
Aug. 1967 9 p ref
(Contract FA-67-WA-1706)
(FAA-DS-67-16)

A contour map which plots noise exposure forecasts for Chicago's O'Hare International Airport and input data tables on which it is based are presented and explained. R.N.A.

N68-10267# Federal Aviation Agency, Washington, D. C. Dept. of Transportation.
AVIATION DEMAND AND AIRPORT FACILITY REQUIREMENT FORECASTS FOR LARGE AIR TRANSPORTATION HUBS THROUGH 1980
Aug. 1967 178 p

For use in advance planning of the physical and financial airport facility development requirements, aeronautical demand forecast data are presented on 22 metropolitan areas which generate 1% or more of the scheduled air carrier domestic enplaned

passengers. These air transportation hubs are New York/Newark, Chicago, Los Angeles, Atlanta, Washington, D.C./Baltimore, San Francisco/Oakland, Dallas/Fort Worth, Boston, Miami/Fort Lauderdale, Detroit/Ann Arbor, Pittsburgh, Philadelphia, Denver, Cleveland, St. Louis, Minneapolis/St. Paul, Kansas City, Houston, New Orleans, Seattle/Tacoma, and Cincinnati. Airport aviation activity forecasts are listed according to type of user, and type of activity. Airport facility requirements, classified according to type of civil user, are quantified in units or area requirements for terminal aprons and buildings, Federal inspection passenger facilities, cargo facilities, and public vehicle parking areas. The techniques, source documents, and other material used in developing these forecasts are described. M.G.J.

N68-10331 Royal Aircraft Establishment, Bedford (England).
SOME OBSERVATIONS ON THE DYNAMICS OF LARGE SLENDER AIRCRAFT
W. J. G. Pinsker [1966] 29 p refs Presented at the AGARD Flight Mech. Panel Stability and Control Session, Cambridge, Sep. 1966

Some typical examples are given of novel control characteristics which are more peculiar to large slender aircraft. As an example from the field of general dynamics, inertia cross couplings has been found to generate large peaks in normal acceleration, in some cases when rudder is applied at high speeds. In the low speed regime, the paper concentrates on control close to the ground, either immediately after lift-off or prior to touchdown, because here control limitations could be most serious. Ground clearance requirements are examined by treating lift-off as a dynamic maneuver, and are found to be defined by conditions 1–2 seconds after unstick. Control requirements are also studied in crosswind landings and for recovery from tail gusts in the final approach. The latter case is shown to pose increasing control difficulties with increasing aircraft size and possible improvements with novel forms of lift control are considered. Author

N68-10364* Flight Safety Foundation, Inc., New York.
CLEAR AIR TURBULENCE
Paul Rosenberg, Samuel P. Saint, and Jerome Lederer Mar. 1967 162 p refs
(Contract NRS-33-026-001)
(NASA-CR-90041) CSCL 01B

This paper is in general concerned with the alleviation of problems posed by flight in turbulence. Specifically, it evaluates developments in: (1) forecasting and detection of air turbulences; and (2) devices for indicating turbulence, with particular emphasis on clear air turbulence (CAT). It also lists incidents and accidents involving turbulence, including their effects on airline operations, for 1965–1966. Although the emphasis is on CAT, a broadened definition of CAT takes in almost all other types of turbulences except those actually within clouds, storms, gales, tornadoes, and hurricanes. Included are studies of pilot/aircraft responses, turbulence reporting, alerting, and aircraft rerouting, engineering aspects of turbulence, and the economics of turbulence. K.W.

N68-10527# Saab Aircraft Co., Linkoping (Sweden).
THE SIZE OF AIRCRAFT FOR A FLUCTUATING TRANSPORT DEMAND
Bjoern J. Elle Sep. 1967 37 p refs
(SAAB-TN-65)

The fluctuations of the demand for individual departures of a public air transport service are due to two different effects: chance and a variable basic demand. These two effects are always super-imposed on each other but their relative significance varies depending on the circumstances. The variation of the basic demand is the dominating factor for the fluctuating occupancy of large aircraft in scheduled service while chance tends to become the dominating factor in traffic with small aircraft, particularly in non-scheduled traffic. It is being shown that on certain conditions, the isolated effect of change is a Poisson distributed demand for the individual departures, and it is being verified that the occupancy of small executive aircraft tends to be distributed accordingly. If the basic demand for a scheduled passenger service is gamma distributed and if a Poisson distribution is superimposed to represent the effect of chance, the demand for individual departures of a scheduled transport service will be distributed according to a negative binomial distribution. Various comparisons with Swedish railway- and airline statistics show that this is the actual trend. Tests against some examples of hotel occupancy show that the negative binomial distribution also offers a good representation of the fluctuating demand for other public services which are associated with travel. Author

N68-10528 Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
NOISE EXPOSURE FORECAST AREAS FOR LOS ANGELES INTERNATIONAL AIRPORT, 1965, 1970 AND 1975
Dwight E. Bishop and Richard D. Horonjeff Aug. 1967 23 p refs
(Contract FA-67-WA-1705)
(BBN-1508; FAA-DS-67-13)

The noise exposure forecast (NEF) areas depict areas of differing land-use compatibility with respect to aircraft noise; hence, the NEF areas may be used as a guide to land-use planning or zoning. The NEF areas are based upon aircraft noise described in terms of the effective perceived noise levels, plus consideration of the number of operations per daytime and nighttime period. NEF areas B and C show a relatively large increase between 1965 and 1970 reflecting a large increase in the number of airport operations and expanded use of Runways 24L and 24R in 1970. Between 1970 and 1975, only a slight increase in NEF areas B and C is observed, since only a moderate increase in total number of operations has been forecast. Author

N68-10663# Elliott Bros., Ltd., London (England). Military Aircraft Controls Div.
THE DESIGN OF AUTOSTABILISERS WITH PARTICULAR REFERENCE TO LOW SPEED HANDLING AND GROUND ATTACK OPERATIONS
G. Belcher 1966 38 p refs Presented at the Specialists Meeting—Stability and Control of the Flight Mech. Panel of AGARD, Cambridge, England, 20–23 Sep. 1966
CFSTI: HC $3.00/MF $0.65

The design and limitations of stability augmentation systems for improving the handling characteristics of aircraft are discussed, consideration being given to pitch rate, yaw rate and β dampers, together with command and artificial stiffness systems. The design of a low speed autostabilizer for the BAC 221 is used to illustrate some of the techniques used in lateral stability augmentation, and the effect of autostabilizer design on aircraft response to gusts is considered. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-10103*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUTOMATED DATA COLLECTION SYSTEM APPLIED TO HALL EFFECT AND RESISTIVITY MEASUREMENTS

Ralph D. Thomas Washington NASA Nov. 1967 26 p refs
(NASA-TM-X-1464) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A description of the instrumentation and theory of operation of a fully programmable automated Hall effect and resistivity apparatus is presented. The apparatus has the capability of controlling all operational conditions over a wide range of temperatures and logging data in the form of both typewritten copy and computer-compatible punched paper tape. Application of the system for measuring both thin film and bulk samples of cadmium sulfide and bulk samples of n-type and p-type silicon in the temperature region between 4.2° and 400°K is discussed. Also discussed are a simple yet highly reliable technique for obtaining ohmic contacts to the samples, the systematic procedure followed for each measurement run, the data program and computer recording format, and samples of the computer results. Extension of the system to include measurement of materials of high resistivity was achieved by operating a high-input-impedance electrometer between the sample leads and the input scanner. A sample holder was designed to accept either thin-film samples on substrates up to 1-inch (2.54 cm) square or bridge-shaped bulk samples. A complete Dewar system was assembled for controlling the temperature and sample environment at temperatures between 4.2° and 400°K. The system accuracy and specifically the accuracy of the reduced Hall effect and resistivity measurements are discussed. Calibration procedures for the thermocouples and gaussmeter are outlined. Author

N68-10173* Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.

ULTRA LOW VOLTAGE DC MOTOR GENERATOR PROGRAM, PHASE I Final Report

N. Ratti [1966] 81 p refs
(Contract NAS5-10221)
(NASA-CR-89991) CFSTI: $3.00 CSCL 10B

This report documents the first phase in the development of a motor generator set, having an input voltage of 0.25 VDC and an output voltage of 28 VDC, for spacecraft use. Of the various design approaches investigated in this phase only a homopolar motor utilizing liquid metal collectors was seen to be capable of specified performance at the ultra low input voltage specified. Limiting design parameters for the motor were identified to be the ability of liquid metal sealing devices to function reliably through the design life of the motor, and an apparent necessity for large current collector areas to obtain acceptable contact voltage drops, with a resulting adverse effect on motor weight. Author

N68-10251*# Bureau of Mines, Pittsburgh, Pa. Coal Research Center.

DEVELOPMENT OF AN IMPROVED OXYGEN ELECTRODE FOR USE IN ALKALINE H_2–O_2 FUEL CELLS Quarterly Report, Apr. 1–Jun. 30, 1967

Sayeed Akhtar, C. T. Grein, R. C. Diehl, W. H. Ryback, and D. Bienstock 30 Jun. 1967 22 p refs
(NASA Order W-12300)
(NASA-CR-89953; Q-4) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Details are presented on the preparation of materials for the catalysts for the cathodic reduction of oxygen. The materials investigated are interstitial compounds of transition metals, singly and in combinations, with carbon, nitrogen, boron, and silicon. An X-ray diffraction study of transition metal alloys is also reported, and the emphasis is placed on the Al–Ni–Co system before and after the leaching of aluminum. Data on the crystal structures of Ni–Co preparations are tabulated. N.E.N.

N68-10578# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.

SEPARATORS FOR HIGH-RATE, NON-RESERVE ZINC–SILVER OXIDE BATTERIES Semiannual Report, 20 Feb.–Jul. 1967

A. Himy and M. P. Strier Sep. 1967 69 p refs
(Contract DAAB07-67-C-0310)
(DAC-59852-S1; ECOM-0310-1; AD-659465)

Separator materials were evaluated for use in high rate, nonreserve zinc-silver oxide batteries capable of operation at temperatures as high as 165F. The films were obtained by blending an inorganic material (previously used to make separators for secondary silver-zinc cells) with an organic binder. Two basic materials designated 3355-25 and 3420-09 were selected to make separators and were evaluated for resistivity, inertness in KOH at 77F and at 165F, silver and zinc diffusion rates, resistance to oxidation by silver saturated KOH solution. Although both materials showed close characteristics, the material 3420-09 was selected for its greater stability in KOH at 165F. For blending, two types of organic binders, K and P, and three procedures were used: the film was cast on glass or Teflon; a slurry was introduced in a porous thin matrix; the silver electrode was dipped in the liquid formulation, resulting in a dip-coated electrode. The results favored the binder P as more stable. The resistivities of the most promising films were in the range of 7 to 15 ohm-cm and the silver ion diffusion rates were lower than those obtained with the inorganic separators on the previous task. A few cells with dip-coated electrodes tested at room temperature maintained an OCV of 1.86 V after 31 days to date. TAB

N68-10579* Boeing Co., Seattle, Wash. Aerospace Group.

LARGE AREA SOLAR ARRAY Final Report, 19 Sep. 1966–1 Nov. 1967

J. W. Ketchum, F. W. McAfee, J. L. Apperson, and R. C. Weikel Oct. 1967 452 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951653)
(NASA-CR-90106; D2-113355-4) CSCL 10A

Descriptions are presented of work in the following areas of endeavor: (1) how the detailed array design was produced and the final design results; (2) what detailed analytical and experimental verification was performed in supplying design data and criteria to the design effort; (3) the ground support equipment preliminary design for the total program; (4) the design testing and test results required to support design; (5) the requirements for tool design, and the manufacturing process and techniques developed and used in fabrication of the small component test specimens and experimental parts; (6) the quality assurance support to the program; and (7) the product assurance and reliability of the design. Author

N68-10810*# Electro-Mechanical Research, Inc., College Park, Md. Aerospace Sciences Div.

PERCENT RECHARGE UNIT Final Report

Aug. 1967 105 p
(Contract NAS5-10379)
(NASA-CR-90099) CFSTI: HC $3.00/MF $0.65 CSCL 10B

This report discusses in detail the operation of the Percent Recharge Unit. This unit works with the formation cycler system which cycles rechargeable battery systems for qualification and acceptance tests. This unit permits the operator to charge each cell of a battery to a percentage (ranging from 100 to 199 per cent) of the discharge capacity of the cell. Author

N68-10812*# Hughes Aircraft Co., Culver City, Calif. Research and Development Div.

NONDISSIPATIVE OPTIMUM CHARGE REGULATOR ADVANCED STUDY Final Report

Robert Rosen, Noel J. Deitrich, John D. Armstrong, Jr., and Bailey M. Fong Jul. 1967 164 p refs
(Contract NAS5-10225)
(NASA-CR-89990; P67-147) CFSTI: $3.00 CSCL 10B

Work efforts and achievements during a study on the design, development, and testing of multiphase nondissipative optimum charge regulators, are summarized. Output characteristics of electrode cells were examined under various charge and discharge conditions. Mathematical models were constructed for all the circuit blocks, and a computer aided worst case analysis was performed utilizing the models to represent the circuit blocks. Failure mode and stress analyses were also completed on all circuit blocks, with several changes initiated based on analytical results. All of the goals of this phase of the regulator study were achieved with the exception of the efficiency requirement for the 250 watt case. Detailed data for the regulator components during testing are presented. L.S.

N68-10625*# Electro-Optical Systems, Inc., Pasadena, Calif.
PLANETARY SOLAR ARRAY DEVELOPMENT Quarterly Report
R. Wizenick 13 Oct. 1967 69 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952035)
(NASA-CR-90102; EOS-7254-Q-1; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This report describes the work completed and in progress at EOS during the first quarter of the Planetary Solar Array Development Study Program. The report finalizes the requirements of Task I, the environmental definitions of the Martian surface, and gives a preliminary review of the possible concepts as defined in Task II of the program outline. Author

N68-10967# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS, DESIGN STUDY Quarterly Technical Progress Report, Mar. 1, 1968–May 31, 1967
A. E. King, ed. 31 May 1967 93 p
(Contract AT(04-3)-679)
(SAN-679-3; QTPR-3) CFSTI: HC $3.00/MF $0.65

Parametric studies to determine minimum system weight as a function of electrical component rating, voltage, frequency, and speed are presented on ac generators, ac motors, power conditioning, and power distribution equipment for 0.25 to 10.0 megawatt space nuclear electric power plants utilizing the Rankine conversion cycle. The power conditioning and distribution equipment includes transformers, rectifiers, frequency changers, contactors, and transmission lines. Concluding parametric data are presented for the electrical system components listed. Electrical power systems are presented to illustrate electrical load break-down on probable missions requiring 0.25 to 10.0 megawatts of power. Experiments to verify analytical techniques for inductor generator designs typical of high-power, high-speed, high-frequency, high temperature applications are presented. Author (NSA)

N68-10970* Yardney Electric Corp., New York.
INVESTIGATION AND IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Final Report
Z. Stachurski Dec. 1965 71 p refs
(Contract NAS5-3873)
(NASA-CR-90232; Rept.-617-65) CSCL 10C

The properties of electrolytes, separators, and zinc deposits (pertaining to zinc penetration through separators in silver-zinc cells) were investigated. A study of the diffusion coefficient of zincate as a function of KOH concentration was made. The absorption and diffusion of zincate in separators were measured. The adsorption of surfactants on mercury was measured and compared with their influence on zinc deposition. Electrodeposition of zinc was carried out in special cells. A relationship between type of zinc deposit and over-potential was established. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-10033*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROBIAL DECONTAMINATION AND SAMPLING PROGRAM FOR ANCHORED INTERPLANETARY MONITORING PLATFORM (AIMP-E) SPACECRAFT
F. N. Le Doux Jul. 1967 34 p Presented at the Joint Symp. of the AEC and NASA, Albuquerque, N. Mex., 12–14 Sep. 1967
(NASA-TM-X-63000; X-723-67-375) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Decontamination was effected with chemical solutions of isopropyl alcohol and acetone. One method of recovering viable microorganisms employed control strips with detachable coupons for monitoring the electronic circuit modules and another method employed sterile swabs and templates to monitor other surface areas. Coupons and/or swabs were immersed in a 1% peptone wash solution and sonicated at 25 kc/sec for 12 minutes. Aliquots of the sonicated solution were plated out on agar, incubated and colony counts made. Records were made of the numbers of aerobic and anaerobic spore and vegetative organisms remaining on a surface after the decontamination process. All assembly and test operations were conducted in controlled and/or clean-room facilities. As a result of the evaluation of records, the AIMP-E spacecraft contained an internal burden of 2.19×10^5 organisms and a surface burden of 4.42×10^4. The surface spore loading was estimated at 7.4×10^3 organisms. This spore population on the surface will be reduced to less than 1.89×10^{-9} due to the spacecraft's orbital life expectancy of 3 years and 1440 cycles of temperature change in an ultra high vacuum. Author

N68-10056*# Farnham (Frank C.) Co., Philadelphia, Pa.
VISCOSITY CHANGES IN THE CYTOPLASMA DURING THE FIRST DEVELOPMENTAL STAGES IN THE FROG EGG [VISKOSITATSVERANDERUNGEN DES ZELLPLASMAS WAHREND DER ERSTEN ENTWICKLUNGSSTUFEN DES FROSCHEIES]
Gustaf Oedquist Washington NASA Oct. 1967 15 p refs Transl. into ENGLISH from Ark. für Entwicklungsmech. der Organ., Wilhelm Roux' (Berlin), v. 51, 1922 p 610–624
(Contract NASw-1497)
(NASA-TT-F-11272) CFSTI: $3.00 CSCL 06C

The author studied changes in the viscosity of *Rana fusca* eggs (unfertilized eggs kept in fresh water, unfertilized eggs left in the dissected oviduct, and unfertilized eggs kept in Göthlin's solution for various lengths of time; and in fertilized eggs at various times following insemination). Viscosity was determined by the degree to which 3 min of centrifugation (radius, 14 cm; rate, 2500 rpm) separated pigment and yolk particles from clear cytoplasm in a given specimen. It was found that there is a great difference in viscosity between unfertilized eggs kept in fresh water and fertilized eggs 2 hrs, 3 hrs, and 3 hrs 30 min after insemination. The viscosity decrease in unfertilized eggs kept in fresh water is attributed to incipient cytolysis due to water absorption. The viscosity of the fertilized eggs drops sharply just before each cleavage and increases again afterwards, to remain high until the next cleavage is ready

to occur. These periodic fluctuations in viscosity, related to the rhythm of cell division, coincide with periods of maximum and minimum susceptibility to damage by KCN, hypoxia, hypothermia, and hyperthermia. Author

N68-10122*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF CELL CULTURE AS A PRIMARY TOXICITY SCREEN OF POSSIBLE SPACECRAFT CONTAMINANTS
Richard B. Hays Washington NASA Nov. 1967 13 p refs
(NASA-TN-D-4251) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Cell culture has been investigated with regard to its applicability as a primary toxicity screen. Forty-nine compounds have been screened by this method. These compounds are all contaminants which may occur in manned spacecraft. The data presented indicate that cell culture can be a useful tool for selecting, from a long list, those compounds most likely to be toxic to a living system. The compounds tested might be ranked, in terms of decreasing toxicity to cells in culture, as follows: unsaturated aldehydes, amines, aldehydes, acids, ketones, and alcohols. Author

N68-10135* Scientific Translation Service, La Canada, Calif.
THE SIGNIFICANCE OF INTESTINAL BACTERIA FOR NUTRITION, II [DIE BEDEUTUNG DER DARMBAKTERIEN FUER DIE ERNAEHRUNG, II]
Max Schottelius Washington NASA Nov. 1967 14 p Transl. into ENGLISH from Arch. Hygiene Bakteriologie (Munich), v. 42, 1902 p 48–70
(Contract NASw-1496)
(NASA-TT-F-11362) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Based on experimental work with sterile chickens the author establishes the fact that the activity of intestinal bacteria is indispensable for the life of plants and for the nutrition of vegetables and man. Author

N68-10149# Army Medical Research Lab., Fort Knox, Ky.
SOME OBSERVATIONS AND MEASUREMENTS OF THE PULFRICH PHENOMENON Interim Report
George S. Harker and Orvil L. O'Neal, Jr. 9 May 1967 11 p refs
(AMRL-728; AD-652705) CFSTI: HC $3.00/MF $0.65

The Pulfrich pendulum was evaluated as a potential screening device for the detection of anomalies of binocular vision. For this purpose, a booth was set up at the Kentucky State Fair (1964) and the general public invited to observe the pendulum and record their responses with the equipment provided. The obtained results indicate that a clear dichotomy can be achieved between those who have binocular vision and those who do not. However, gradiations of binocular vision from poor to good cannot be achieved with the pendulum as presently understood. Contrary to explanatory theory the characteristic seen shape of the seen pendulum path was asymmetrical following the rule that the path was displaced away from the observer on the side of the filtered eye. Author (TAB)

N68-10179* Duke Univ., Durham, N. C. Dept. of Physiology and Pharmacology.
ACTION POTENTIALS WITHOUT CONTRACTION IN FROG SKELETAL MUSCLE
Robert S. Eisenberg and Peter W. Gage [1967] 10 p refs
(Grant NGR-34-001-005)
(NASA-CR-90047) CSCL 06C

In muscle fibers which have been exposed to a 400 mM glycerol-Ringer solution for 1 hour and then returned to Ringer solution, propagated action potentials with no after-depolarization can be observed. These action potentials cause no contraction. The uncoupling of excitation and contraction is attributed to the absence of transverse tubules after this treatment. The results indicate that action potentials gain access to the contraction-activating mechanism by way of the transverse tubular system. Author

N68-10181*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A REVIEW OF MEDICAL RESULTS OF GEMINI 7 AND RELATED FLIGHTS
Aug. 1966 298 p refs Review held at NASA. John F. Kennedy Space Center, 23 Aug. 1966
(NASA-TM-X-60589) CFSTI: HC $3.00/MF $0.65 CSCL 06S

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8. HUMAN OTOLITH FUNCTION: MEASUREMENTS IN GEMINI FLIGHTS V AND VII A. Graybiel and E. F. Miller, II (Naval School of Aviation Medicine) p 190–249 refs (See N68-10189 01-04)

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10. SUMMARY OF MEDICAL EXPERIMENTS PROGRAM REVIEW OF FINDINGS THROUGH GEMINI 7 S. P. Vinograd (NASA, Washington) p 281–287 (See N68-10191 01-04)

N68-10182*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CARDIOVASCULAR CONDITIONING
Lawrence F. Dietlein and William V. Judy *In its* A Rev. of Med. Results of Gemini 7 and Related Flights Aug. 1966 p 1–35 refs (See N68-10181 01-04)

The equipment used in the experiment consisted of a pneumatic timing or cycling system which alternately inflated and deflated the leg cuffs attached to the Gemini astronauts' thighs. The experiment was conducted to determine the efficacy of such a technique in protecting against cardiovascular deconditioning. Preflight and postflight tilt-table tests were given to the crews, and summary data on the heart rate changes and blood pressures are tabulated. The results observed in the Gemini V and VII pilots are assessed and compared. Based on preflight and postflight data, it was concluded that the pulsatile cuffs were not effective in lessening postflight orthostatic intolerance. This conclusion was reached due to the higher heart rates observed during subsequent tilts, as compared with the control subject. However, the pulsatile cuffs appeared to be effective in lessening the degree of postflight pooling of blood in the lower extremities as judged by the strain gauge technique. M.G.J.

N68-10183*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

INFLIGHT EXERCISE—WORK TOLERANCE

Lawrence F. Dietlein and Rita M. Rapp *In its* A Rev. of Med. Results of Gemini and Related Flights Aug. 1966 p 36–47 refs (See N68-10181 01-04)

Utilizing mild exercise as a provocative stimulus, no significant decrement in the physical condition of either of the Gemini VII crewmembers was apparent. The rate of return of the pulse rate to preexercise levels, following inflight exercise periods, was essentially the same as that observed during preflight baseline studies. The objective was the day-to-day evaluation of the general physical condition of the flight crew with increasing time under space flight conditions. The basis of this evaluation was the response of the cardiovascular system (pulse rate) to a calibrated workload. Author

N68-10184*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

INFLIGHT PHONOCARDIOGRAM

C. Vallbona (Baylor Univ., Houston, Tex.) and Lawrence F. Dietlein *In its* A Rev. of Med. Results of Gemini and Related Flights Aug. 1966 p 48–67 refs (See N68-10181 01-04)

Simultaneous electrocardiographic and phonocardiographic records were obtained on both crew members during the flight of Gemini IV and Gemini V, and on the pilot of Gemini VII. Analysis of the data recorded during flight revealed: (1) wide fluctuations of the duration of the cardiac cycle within physiological limits throughout the mission; (2) fluctuations in the duration of the electromechanical systole that correlated with the changes in heart rate; (3) stable values for the electromechanical delay; (4) higher values for duration of systole and electromechanical delay in the command pilot of Gemini V suggesting cholinergic influences; and (5) evidence of adrenergic response at lift-off, at reentry, and for the few hours preceding reentry. This adrenergic response was observed in all astronauts participating in this experiment. Author

N68-10185*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

BIOCHEMICAL ANALYSIS OF BODY FLUIDS IN MANNED SPACEFLIGHT

Harry S. Lipscomb (Baylor Univ., Houston, Tex.), Elliot Harris, and Lawrence F. Dietlein *In its* A Rev. of Med. Results of Gemini and Related Flights Aug. 1966 p 68–81 (See N68-10181 01-04)

Biological fluids were analyzed to determine the metabolic cost of manned spaceflight, and the results were assessed to obtain an indication of the physiological status of the astronaut. The measurements consist of (1) preflight collection of urine samples and whole blood from each crewman to establish baseline values; (2) a determination of their physiological status by analyzing urine samples collected inflight; and (3) the use of urine and blood samples collected immediately postflight, and at 24 and 48 hours postflight, to establish the rate of return to baseline preflight values. The biochemical determinations consist essentially of fluid and electrolyte balance and hormonal studies, and correlation of the two. The inflight findings show significant decreases in fluid intake and urinary output; marked decreases in urinary excretion of sodium, chloride, and potassium; and a trend toward elevation of aldosterone. Upon reentry, considerable increases were noted in catecholamine excretion and 17-hydroxycorticosteroids. M.G.J.

N68-10186*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

REVIEW OF MEDICAL FINDINGS OF GEMINI VII AND RELATED MISSIONS—BONE DEMINERALIZATION

Pauline Beery Mack (Tex. Womans Univ.), Paul A. La Chance, George P. Vose (Pa. State Univ.), and Fred B. Vogt (Tex. Univ.) *In its* A Rev. of Med. Results of Gemini and Related Flights Aug. 1966 p 82–126 refs (See N68-10181 01-04)

Bone demineralization experiments were conducted on the primary and backup crews of the 14-day Gemini VII mission to determine the effect upon the human skeletal system of prolonged weightlessness and immobilization. Radiographic bone densitometry techniques were used, and radiographs were made preflight and postflight of the left foot in lateral projection and of the left hand in posterior–anterior projection. Sections of the bones of the foot and hand were evaluated for changes in skeletal mineralization. Comparisons were drawn with the results of ground-based bed rest studies in which calcium provision in the diet was varied. Also considered were the effects on the crews of the Gemini IV and V flights. The results show: (1) The food intake level is a major parameter in accounting for the differences in levels of mineral loss by the astronauts. (2) The isotonic and isometric exercises engaged in by the Gemini VII crew was partly responsible for the comparatively low losses in foot bone mass. (3) Skeletal losses were replaced shortly after termination of the flight. M.G.J.

N68-10187*# National Institutes of Health, Bethesda, Md.

CALCIUM AND NITROGEN BALANCE

G. Donald Whedon, Leo Lutwak (Cornell Univ., Ithaca, N. Y.), and William Neuman (Rochester Univ.) *In* NASA. Manned Spacecraft Center A Rev. of Med. Results of Gemini 7 and Related Flights Aug. 1966 p 127–165 (See N68-10181 01-04)

The effects of several variables on certain parameters related to overall body economy were measured to assess the results of space flight stress on the performance of the crew and back-up crew of the Gemini VII. Measurements were made of the calcium in the urine, feces, diet, and sweat, as well as magnesium, sodium, potassium, phosphate, sulfate, chloride, and nitrogen, during the preflight control, inflight, and postflight phases. The data show: (1) Sweat losses were insignificant throughout, comprising less than one milliequivalent of calcium at any phase of the study. (2) Urinary losses of calcium increased inflight, and increased by a greater amount during the second week of flight. The intake was less inflight by about 300 milligrams, and the net result was slightly negative calcium balance. (3) Significant differences in magnesium, nitrogen, sodium, and potassium balance changes were attributed to dietary intake variability. M.G.J

N68-10188*# Baylor Univ., Houston, Tex.

INFLIGHT SLEEP ANALYSIS

Peter Kellaway and Robert L. Maulsby *In* NASA. Manned Spacecraft Center A Rev. of Med. Results of Gemini 7 and Related Flights Aug. 1966 p 166–189 refs (See N68-10181 01-04)

The electroencephalogram of Command Pilot Frank Borman was recorded continuously during the first two days of the Gemini VII flight. This attempt to record EEG was designed to study sleep cycles during flight and to assess the effect of weightlessness upon the electrical activity of the brain. The technique used and the preliminary results of visual interpretation of the record are discussed. The two sleep periods which occurred were evaluated visually for depth of sleep versus time on a minute-to-minute basis. The first sleep period was found to be inadequate in terms of depth and length, but the second sleep period was normal. The tracing during the alert state, including ascent and orbital flight, showed no pathological changes and no definite alterations which could be attributed to weightlessness. It is concluded that these preliminary results confirm the view that orbital flight has no apparent deleterious effect on cerebral function. Author

N68-10189*# Naval School of Aviation Medicine, Pensacola, Fla.

HUMAN OTOLITH FUNCTION: MEASUREMENTS IN GEMINI FLIGHTS V AND VII

Ashton Graybiel and Earl F. Miller, II *In* NASA. Manned Spacecraft Center A Rev. of Med. Results of Gemini 7 and Related Flights Aug. 1966 p 190–249 refs (See N68-10181 01-04)

The Gemini V and VII astronauts were involved in two experimental probes related to the human otolith function. One was concerned with the influence of nonvisual cues on spatial localization. The astronauts' task was to set a dim line of light in an otherwise dark field to an external horizontal reference; the earth's horizontal was used pre- and postflight and an element in the spacecraft, horizontal with respect to the astronaut, was used inflight. The outstanding finding was the small intratest variance in the settings made inflight and relatively small bias in three of the four astronauts. The other experiment consisted in the pre- and postflight measurement of ocular counterrolling which depended mainly on a reflex response having its genesis in the otolith apparatus. No significant differences in response were demonstrated.
Author

N68-10190*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SUMMARY AND CONCLUSIONS CONCERNING MEDICAL RESULTS OF THE GEMINI VII MANNED SPACE FLIGHT

Charles A. Berry *In its* A Rev. of Med. Results of Gemini 7 and Related Flights Aug. 1967 p 250–280 (See N68-10181 01-04)

Summary data are presented on the results obtained from pre- and postflight medical studies consisting of physical examination, blood, urine, and X-ray analyses. These are supplemented by inflight observations made by realtime physiological monitoring and adequate reporting of the crews inflight, and from postflight debriefings. The adaptive physiology noted in man's response to the flights and readaptation to a 1-g environment is discussed. Figures are included to depict the heart rate tilt response compared with mission duration; and the Gemini pilots' white blood cell response, blood volume, hemolysis, ergometry, heart rates, and blood pressures.
M.G.J.

N68-10191*# National Aeronautics and Space Administration, Washington, D. C.

SUMMARY OF MEDICAL EXPERIMENTS PROGRAM. REVIEW OF FINDINGS THROUGH GEMINI 7

S. P. Vinograd *In* NASA. Manned Spacecraft Center A Rev. of Med. Results of Gemini 7 and Related Flights Aug. 1966 p 281–287 (See N68-10181 01-04)

Discussion centers on the experiments conducted to determine effects, mechanisms, predictive means, and the most effective preventive or corrective measures to protect man's welfare in space flight and on very long duration missions of the future. Negative and positive findings are assessed in relation to studies on cardiovascular reflexes, exercise tolerance, phonoelectrocardiograms, bioassays of body fluids, bone densitometry, mineral balance, electroencephalograms, and human otolith functions. Important contributions in the areas of red cell enzymology, dehydration, and fluid balance are foreseen.
M.G.J.

N68-10198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHYTOPLANKTON AS AN AGENT OF THE SELF-PURIFICATION OF CONTAMINATED WATERS [FITOPLANKTON KAK AGENT SAMOOCHISHCHENIYA ZAGRYAZNENNYKH VOD]

G. G. Vinberg and T. N. Sivko 18 Aug. 1967 43 p refs Transl. into ENGLISH from Tr. Vsesoyuznogo Gidrobiol. Obshchestva Akad. Nauk SSSR (USSR), v. 3, 1956 p 3–23
(FTD-MT-66-13; AD-659310)

Planktonic algae when grown on a large scale on undiluted city sewage sharply accelerate the process of self-purification; this is expressed in faster initial lowering of the biological oxygen content (BOR), early termination of the anaerobic phase, the appearance of free oxygen, and in the accelerated onset of nitrification. The accumulation of a large quantity of organic substances synthesized by the algae in the composition of the bodies of the living cells is not reflected in the magnitude of the BOR. With the large-scale development of green algae in self-cleaning sewage the death rate of coliform bacterium is sharply increased. The construction of ponds filled with undiluted sewage is the simplest way to use green organisms as agents of self-purification; it draws attention also as an effective method of purification, especially applicable in regions with warm dry climates. Further study of the conditions favorable to the development of photosynthesizing planktonic organisms will allow setting up problems in the large-scale cultivation of algae as one of the methods of utilizing sewage. In particular one should clarify the possibility of using algae grown on sewage to increase the productivity of piscicultural ponds.
Author

N68-10200*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.

THE EFFECT OF REPETITIVE FEEDINGS ON THE ACCEPTABILITY OF SELECTED METABOLIC DIETS

Carol A. Linder and Vickie R. Must Wright-Patterson AFB, Ohio AMRL Jun. 1967 8 p refs Presented at the 45th Ann. Meeting of the Ohio Dietetic Assoc., Dayton, Ohio, 11–13 May 1966 (NASA Order R-85; Contract AF 33(657)-11716)
(NASA-CR-90105; AMRL-TR-66-75; AD-659386) CFSTI: HC $3.00/MF $0.65 CSCL 06P

In three separate metabolic balance studies, the repetitive serving of a liquid, fresh food, and experimental bite-sized, compressed and dehydrated diet was evaluated by means of a graduated hedonic scale for organoleptic acceptability for extended periods of time. A liquid diet, having a low degree of initial acceptability, become monotonous when served for twenty-one days. However, both the one-day cycle menu of fresh foods and the two-day cycle menu of experimental foods remained acceptable over periods of forty-two and thirty days, respectively, since significant differences among individuals has been demonstrated, and because repetition does not necessarily result in decreased acceptance, more emphasis should be placed on the variation in food preferences on individuals. Perhaps dietitians and homemakers could benefit by using a simple food preference questionnaire, prior to actual menu planning, to ascertain the preferences of the individuals they are responsible for feeding. In relation to the acceptability of individual food items on the fresh diet, it was found that all beverages, peaches, brownies and poundcake, and sliced turkey contributed most to the high acceptability of this diet.
Author (TAB)

N68-10227*# Farnham (Frank C.) Co., Philadelphia, Pa.

ELECTRONIC ASPECTS OF THE MECHANISMS OF THE LETHAL AND MUTAGENIC ACTION OF ULTRAVIOLET LIGHT [ELEKTRONNYYE ASPEKTY MEKHANIZMOV LETAL'NOGO I MUTAGENNOGO DEYSTVIYA UF-SVETA]

G. G. Dyadyusha, V. I. Danilov, and O. V. Shramko Washington NASA Nov. 1967 8 p refs Transl. into ENGLISH from Molekul. Biol. (USSR), v. 1, no. 4, 1967 p 539–543
(Contract NASw-1497)
(NASA-TT-F-11339) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The lowest triplet states of pyrimidine bases (PB) and PB derivatives have been studied by the self-consistent-field open-shell and closed-shell methods. Triplet excitation is almost completely localized on the 5–6 bond; this fact favors the reaction of photodimerization. A correlation between the degree of triplet state localization on the 5–6 bond and the ease of photodimerization is demonstrated. Investigation of the ground state of cytosine and cytosine hydrate in neutral and cationic forms shows that the deaminization reaction of cytosine hydrate proceeds through the protonic stage. The relationship between the data obtained and the mutagenic effect of ultraviolet light is discussed.
Author

N68-10232* Duke Univ., Durham, N. C. Dept. of Physiology and Pharmacology.

THE ROLE OF THE ELECTROCHEMICAL GRADIENT IN DETERMINING POTASSIUM FLUXES IN FROG STRIATED MUSCLE

P. Horowicz, P. W. Gage, and R. S. Eisenberg [1965] 22 p refs

(Grant NGR-34-001-005)

(NASA-CR-90061) CSCL 06C

Experiments were conducted to study the unidirectional potassium fluxes for two types of conditions. In one type, the potassium equilibrium was varied by changing $[K^+]_o$ while the internal potential, V_i, was kept constant. In the other type, the transmembrane potential was varied by changing $[Cl]_o$ while the potassium equilibrium potential was kept constant. These methods are based on the observation that, under appropriate conditions, the transmembrane potential can be made to depend mainly on chloride ion concentration while being relatively insensitive to changes in external potassium ion concentration. The experimental observations described were performed on small bundles of muscle fibers isolated from the semitendinous muscles of *Rana pipiens*. Measurements were made of the internal potential, $^{42}K^+$ influx, and $^{42}K^+$ efflux on preparations initially equilibrated in a Ringer's fluid to which KCl was added so that the final external $[K^+]$ and $[Cl^-]$ were 100 and 217 mmole/liter, respectively. R.N.A.

N68-10273# Army Medical Research Lab., Fort Knox, Ky. Pathology Div.

THRESHOLD LESIONS INDUCED IN PORCINE SKIN BY CO_2 LASER RADIATION Interim Report

Arnold S. Brownell, Wordie H. Parr, David K. Hysell, and Robert S. Dedrick 7 Jun. 1967 15 p refs

(AMRL-732; AD-659347)

The skin of white pigs was exposed to CO2 laser radiation with varying combinations of power density and exposure time. The dose-response relationship for threshold burns has been determined for power densities within the range of 1 to 8 watts/sq cm and exposure times 0.4 to 18 sec. In the range from 1.5 to 8 watts/sq cm the data fit the equation H = 4.13 t to the minus .807 power where H = incident power density (watts/sq cm) and t = median effective exposure time (sec). Limited data suggest that below 1.5 watts/sq cm this relationship changes. The data provide information for establishing safety standards for CO2 laser radiation. Author (TAB)

N68-10277*# Spacelabs, Inc., Van Nuys, Calif.

BIOLOGICAL SPECIMEN STORAGE FOR EXTENDED SPACE MISSIONS Final Report

1 Oct. 1967 56 p refs Prepared in cooperation with Bio-Sci. Labs., Inc.

(Contract NASw-1556)

(NASA-CR-90029; SR-67-1043) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Methods for preserving biological specimens for post-flight analysis are discussed and evaluated. Details are given on chemical, refrigeration, freezing, vacuum distillation, absorption and ion exchange, and lyophilization methods. Specimen collection and microbiological flora are considered. Lyophilization was found to be the most complex method, and to offer advantage only for LDH isozymes in serum and plasma. A freezer of 300 to 500 cubic inches and 15 to 22 pounds is recommended for blood, urine, serum, and plasma. The freezer could also be used for sweat and feces. It is also recommended that provision be made for obtaining dried blood smears on paper or glass for platelet count, reticulocyte count, and WBC differential. N.E.N.

N68-10367* Spacelabs, Inc., Van Nuys, Calif.

PHYSICAL METHODS FOR BIOCHEMICAL ANALYSIS IN SPACEFLIGHT Final Report

1 Oct. 1967 184 p refs Prepared in cooperation with Bio-Sci. Labs., Inc.

(Contract NASw-1556)

(NASA-CR-90032; SR-67-1044) CSCL 06A

The current instrumentation and techniques suitable for on-board space flight biochemical analysis are discussed. Several methods, such as flame photometry and centrifuges, were considered to be hazardous or to have adverse effects on the spacecraft. Techniques investigated are photometry, X-ray spectrometry, coulometric–amperometric titrimetry, gas–liquid chromatography, fluorometry, specific ion electrodes, neutron activation, and refractometry. Adaptability to simple handling by means of filter paper and cappillary tubes was emphasized. Normal human values, a brief description of photometric procedures, and an extensive bibliography are included. N.E.N.

N68-10410# Naval Medical Research Inst., Bethesda, Md. Dept. of Behavioral Sciences.

PROJECT ARGUS 1967: FIVE YEAR REVIEW AND PREVIEW

William W. Haythorn Aug. 1967 60 p refs

(Rept.-31; AD-657862)

The report summarizes research progress under Project ARGUS for the period October 1965 to June 1967, and presents research plans for the five years 1968 - 1972. The accomplished research reported includes work on groups in isolation, social penetration, ecological aspects of behavior, sensory reduction, affect measurement, comparative monotony, activity measures, social comparison processes, behavioral contagion, Project SEALAB, expectancy confirmation, and stress. The report summarizes research described in more detail in 55 journal articles, chapters, and presentations to professional societies. The project plans for the next five years envision continuing efforts in most of the above areas, with an increased emphasis on training, computer modelling, and larger isolated groups. Author (TAB)

N68-10435# Oklahoma Univ., Oklahoma City. Dept. of Dermatology.

PHYSIOLOGICAL RESPONSE OF HUMAN SKIN TO ULTRAVIOLET LIGHT

Mark Allen Everett and Robert L. Olson 20 Jul. 1967 9 p refs Presented at the 13th Intern. Congr. of Dermatol., Munich

(Contract AT(40-1)-3578)

(ORO-3578-2; CONF-670719-2) CFSTI: HC $3.00/MF $0.65

Recent research on uv-induced erythema provided much new data regarding the reaction of human skin to ultraviolet light. A review of the studies revealed that in the spectral range of 250 to 310 mμ, cutaneous erythema was directly wavelength dependent; the shorter the wavelength, the less the minimal erythema dose (MED). Time of day and interruption of the light beam does not affect resultant erythema. The energy required to produce erythema was significantly modified by such factors as anatomic location, angle of the incident light, thickness of the stratum corneum, time of observation, and size of the field of exposure. Author (NSA)

N68-10484# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Dept. Protection Sanitaire.

RADIOACTIVE CONTAMINATION LEVELS IN THE ENVIRONMENT AND THE FOOD CHAIN [NIVEAUX DE CONTAMINATION RADIOACTIVE DU MILIEU AMBIANT ET DE LA CHAINE ALIMENTAIRE] Annual Report, 1966

Brussels EURATOM 1967 56 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-003-63-10-PSAF)

(EUR-3553.f)

In human biology a special effort was made to determine anatomical data of European man and their evolution with age. The programme designed to study the metabolic factors of strontium and their evolution during growth has been set up. The estimation

of food consumption and of its variation with age, with data from the dietary enquiries carried out in eleven regions, is nearly finished. Some results are available. Investigations on different factors of transfer of radioactive contamination from the polluted environment to food are being continued. Some results have been obtained from complementary experimental research. Various mathematical models concerning strontium metabolism have been studied. A method of calculating the critical age group from biological and nutritional data and from radioecological factors of transfer have been worked out. Finally, a programme investigating the distribution network of some of the most important foodstuffs in the six countries of the European Community has been initiated. Author

N68-10522# Japan Atomic Energy Research Inst., Ibaraki
EFFECTS OF RADIATION ON THE CHROMOSOMES OF THE BONE MARROW CELLS
Noboru Ozono Mar. 1967 30 p refs Transl. into ENGLISH from Acta Haematol. (Karger), v. 28, no. 3, Jun. 1965 p 308–318 Submitted for publication
(NSJ-TR-78)

Chromosome studies were undertaken on the bone marrow cells of atomic bomb survivors in Hiroshima and of irradiated rats. No chromosome abnormalities in number or structure were found in 1968 bone marrow cells obtained from 39 individuals examined from 1962 to 1964 (16–19 years after exposure to the atomic bomb). Observations were made on the chromosomes of the bone marrow cells of rats at various intervals from three hours to ten months following 200 rads of X-rays, ^{60}Co γ rays, and 14.1-Mev fast neutrons. There were a number of chromosome abnormalities, a majority of which were chromatid aberrations, within three hours after irradiation. As time elasped the aberration rate fell rapidly, and stable chromosomal abnormalities such as pericentric inversions, chromosome deletions, and translocations were observed. Although frequencies of aberrant chromosomes were very low, they persisted ten months after irradiation. Morphological studies of the irradiated bone marrow indicated that most of the cells with chromosomal abnormalities observed shortly after irradiation originated from erythroblasts. Giant cells and multilobulated cells found 12–24 hours following irradiation were chiefly granulocytic. Author (NSA)

N68-10525*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A SURVEY OF IN VIVO ENERGY SOURCES
J. J. Konikoff Washington Am. Inst. of Biol. Sci. 1 May 1967 21 p refs
(Contract NAS2-1420)
(NASA-CR-90103) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Recent engineering advances in medicine have permitted the application of various protheses for the correction of physiological defects. Such devices as cardiac pacemakers, diaphragm stimulators, and artificial limbs have been greatly improved in effectiveness. Long term implants of electronic gadgetry have also become relatively commonplace in the biomedical community as a means for measuring several physiological parameters *in situ*. In both cases cited above, the power supply plays a vital role–because of its impact on the volume and life of the device. Although miniature batteries are doing an effective job in these applications, their two- or three-year life requires surgical procedure for replacement. To reduce this, other energy sources are being investigated. One approach is to use the body during its normal functioning to drive an electric power source. Bioelectric potentials, muscle motions, and implanted fuel cells are some of the approaches being investigated with varying degrees of success. (Another approach is to transmit the power through the skin by inductive coupling or in the form of radio frequency energy. This technique relieves the problems of battery life since the power pack is external and can be easily replaced.) Author

N68-10545# Oxford Univ. (England). Dept. of Zoology.
OSCILLATORY CONTRACTILE MECHANISM OF INSECT FLIGHT MUSCLE Interim Scientific Report, 1 Jul. 1966–31 Jul. 1967
J. W. S. Pringle 31 Jul. 1967 57 p refs
(Grant AF-EOAR-66-52)
(AFOSR-67-2253; AD-659463)

The flight muscles of giant water bugs provide the best material for a study of the peculiar properties of insect fibrillar muscle. Although little was previously known about the biology of these insects, three species, Lethocerus maximus, L. annulipes and B. Malkini have now been extensively studied in the field in Trinidad and the techniques for breeding L. maximus and B. malkini worked out. Against the background of studies carried out in Oxford in the last four years (Pringle, 1967) special attention was given to the biochemistry of the ATPase activity of actomyosin and myofibrils prepared from fibrillar flight muscles (Maruyama and Allen, 1967; Maruyama, Pringle and Tregear, in press). This enzyme is similar to that from vertebrate muscle in its sensitivity to ionic strength and its requirements for MgATP as substrate but its dependence on the concentration of Ca(2+) is different and this is related to the stretch activation shown by intact glycerinated muscle preparations (Ruegg and Tregear, 1966). Previous studies (Chaplain, 1966) suggested an important role for ADP in the control of ATPase activity of insect actomyosin. Further studies show that the ionic strength of the medium has an important effect on the inhibition or activation produced by ADP (Maruyama and Pringle, 1967). Author (TAB)

N68-10551# Hazleton Labs., Falls Church, Va.
DEVELOPMENT OF THE FIREFLY BIOLUMINESCENT ASSAY FOR THE RAPID, QUANTITATIVE DETECTION OF MICROBIAL CONTAMINATION OF WATER Final Report, 1 May 1966–31 Mar. 1967
Gilbert V. Levin, Chi-sin Chen, and Gretchen Davis Wright-Patterson AFB, Ohio AMRL Jul. 1967 86 p refs
(Contract AF 33(615)-3996)
(AMRL-TR-67-71; AD-659144)

Research was conducted toward development of a sensitive, biologically nonspecific assay technique which uses the firefly bioluminescent reaction to detect ATP extracted from microorganisms present in water supplies. An instrument using a photomultiplier to detect the light output from the bioluminescent reaction was designed, constructed, and tested. Cultures of a wide variety of organisms were grown, both heterotrophic and autotrophic, and included numerous species of bacteria, algae, fungi, and protozoa. The tests demonstrated the ability to detect concentrations of only a few hundred cells of any of the test species and in many cases less than 100 cells in less than 30 seconds. The ATP response is related to number of cells and cell size and can be used as a measure of the number of cells per volume of sample if something is known of the cell size. Development of a differential filtering technique may be necessary to obtain highest accuracy in quantitation if cells of varying size are encountered. The inherent light level of the enzyme solution without ATP added varies from day to day and consequently the net response of the instrument - gross response less inherent light - is the best measure of ATP level. The assay technique may have applicability to terrestrial water supplies - particularly under hazardous or difficult conditions - as well as to spacecraft waters. TAB

N68-10558# Kansas State Univ., Manhattan. Inst. for Environmental Research.
HUMAN PHYSIOLOGICAL RESPONSES TO SHELTER ENVIRONMENT, SEPTEMBER 1965–NOVEMBER 1966
Frederick H. Rohles, Jr., Ralph G. Nevins, and Preston E. McNall, Jr. Feb. 1967 131 p refs Prepared for Army Dept.
(Rept.-2; AD-659403)

Three studies were conducted in simulated shelter environments. In Study A two experiments were conducted to determine the effects of subject-packing on changes in body temperature. Four pack conditions were studied using 8, 18, 32 and 48 subjects, respectively. In Experiment I the groups were exposed to 95, 98, 100 and 105F(DB) at 80%RH for 4 hours. Experiment II examined the physiological responses of these groups at 95 and 98F(DB) and 60, 70, 80 and 90%RH for 8 hours. The results of the first experiment supported the hypothesis that under crowded conditions the body temperature will rise faster than under less-crowded conditions. There is also support for this hypothesis in the second experiment; however, the results were not as conclusive. In Study B, experiments were conducted to establish upper limits non-stress shelter environments for men operating a Package Ventilation Kit (PVK). Eight subjects were exposed to DBTs ranging from 80F to 100F at 5F increments when the RH was 80%. Exposure was for a maximum of 8 hours and the subjects worked (pedaled) 15 minutes and rested 15 minutes. The upper limits of the non-stressful environments were: 90F DB at 0.05 hp/man; 85F DB at 0.10 hp/man; and 80F DB at 0.15 hp/man. The purpose of Study C was to determine the acceptability of stored water and to establish ad lib. water consumption at various thermal environments. Six 24 hour tests at ETs of 82.0, 85.0 and 88.0 were conducted with 3 groups of 8 male subjects. The results showed that the mean water intake was independent of the type of water. Author (TAB)

N68-10608# California Univ., La Jolla. Dept. of Aerospace and Mechanical Engineering Sciences.
TWO-DIMENSIONAL FINITE DEFORMATION EXPERIMENTS ON DOG'S ARTERIES AND VEINS
Jen-shih Lee, Wallace G. Frasher, Jr., and Yuan-cheng B. Fung Aug. 1967 35 p refs
(Grants AF-AFOSR-1186-67; PHS-G-HE-11152)
(AFOSR-67-1980; AD-659546)

Most published data on the blood vessel elasticity were obtained either in simple elongation or in simple inflation, but not simultaneously. For finite deformations, such data are insufficient to formulate a three-dimensional stress-strain law even if the material is isotropic and incompressible. Since the blood vessels are highly nonlinear, the Youngs modulus for a specimen varies continuously from almost zero at the undeformed state to a large final value, and a statement of the modulus without the corresponding stress level is meaningless. The purpose of the experiments reported in this paper is to illustrate a scheme remedying these difficulties. The tests consist of (1) a longitudinal stretching while the diameter of the vessel was maintained, (2) a lateral distension with the length of the vessel fixed, (3) stress relaxation at fixed strain, and (4) cyclic deformation. Two Lagrangian stresses (stresses based on the vessels undeformed state) and two extension ratios are used to describe the deformed state of the vessel under a symmetric loading. The nonlinearity in the elasticity, and the dependence of the stress on the strain-history is demonstrated. Author (TAB)

N68-10618 Joint Publications Research Service, Washington, D. C.
PHYSIOLOGICAL MECHANISMS OF THE ACTION OF ACCELERATIONS
A. A. Sergeyev 22 Nov. 1967 438 p refs Transl. into ENGLISH of "Fiziologicheskiye Mekhanizmy Deystviya Uskoreniy" Leningrad, Nauka Publ. House, 1967 p 1–391
(JPRS-43412) CFSTI: $3.00

Based on experimental data on the effect of accelerations, the question of whether there is any limit to the speed which can be tolerated by the human body is examined. Acceleration concepts are discussed in relation to the three types of accelerations known in mechanics: positive linear acceleration; negative linear acceleration, or deceleration; and radial or centrifugal acceleration. The physiological and pathological phenomena experienced by different systems of the body under acceleration stress are considered, and the capacity of man for physiological adaptation to environmental conditions by means of compensatory mechanisms is evaluated. Emphasis is focused on the various aspects of the mechanisms for imparting linear accelerations; and the physiological mechanisms of radial acceleration effects, and acceleration effects during space flights. An extensive bibliography is included. M.G.J.

N68-10628* Public Health Service, Cincinnati, Ohio.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, 1 Jul.–30 Sep. 1967
Robert Angelotti Oct. 1967 14 p refs
(NASA Order R-36-015-001)
(NASA-CR-90097; QPR-10) CFSTI: $3.00 CSCL 06M

The dry heat resistance of Bacillus subtilis var. niger spores on stainless steel strips was detemined. D values at 115°, 125°, and 135°C were obtained and a z_D value calculated. In addition, a thermal death time curve for spores trapped between mated surfaces at 150 inch-pounds of torque was plotted from D values reported in the Ninth Quarterly Report of Progress. A z_D value was determined from the curve and reported. Finally, the effect of water activity on the thermal resistance of spores was investigated. In this system, spores were dried on glass and exposed to various water activities prior to heating. Results from these experiments substantiated earlier findings indicating that intermediate water activities increase dry heat resistance of spores. Author

N68-10632# Sandia Corp., Albuquerque, N. Mex.
LASER EYE HAZARD EVALUATIONS
W. D. Burnett Aug. 1967 18 p refs
(SC-RR-67-563) CFSTI: HC $3.00/MF $0.65

Equations for calculating direct laser intensity levels on the human retina are described and related to so-called safe retinal intensity levels extracted from a review of current literature. Author (NSA)

N68-10645*# Miami Valley Hospital, Dayton, Ohio.
EFFECTS OF EXPERIMENTAL DIETS AND SIMULATED SPACE CONDITIONS ON THE NATURE OF HUMAN WASTE
A. R. Slonim and H. T. Mohlman (Dayton Res. Inst.) Wright-Patterson AFB, Ohio AMRL Nov. 1966 33 p refs Prepared jointly with Dayton Univ. Res. Inst.
(NASA Order R-85; Contracts AF 33(657)-11716; AF 33(615)-2182)
(NASA-CR-90114; AMRL-TR-66-147; AD-659143) CSCL 06K

The effects of three different types of experimental diets and three environmental conditions on the nature of human waste were evaluated in a series of experiments over a 2-year period to provide waste management criteria for space systems. These effects were assessed in 36 healthy subjects in terms of defecation rate, fecal mass, protein, fat, fiber, and physical characteristics, along with some urine properties and water consumption. Dehydrated foods, full pressure suits, strict confinement and heat stress (32 C) did not alter any of the waste properties. The liquid foods under examination caused a significant but not consistent increase in fecal mass. The greatest effect of diet was observed with compressed bite-sized food, resulting in a significant ($P < 0.01$) and persistent increase in fecal fat and mass as well as a change to a soft fecal consistency. This steatorrhea condition plus the high correlation of fat between experimental diet and feces emphasize the importance of selecting the proper quality of fat in the diet. Differences between and within subjects were observed. Time differences and interactions varied according to experimental design or condition; these differences plus some degree of carry-over in feces from one diet into another diet period stress the importance of having adequate adjustment periods before evaluation of diets.

Other characteristics of the diet were evaluated also. Of all the experimental conditions studied, only heat stress caused a very significant change in water consumption. Author (TAB)

N68-10683# Technology, Inc., San Antonio, Tex. Life Sciences Div.

RESEARCH ON OCULAR EFFECTS PRODUCED BY THERMAL RADIATION Final Report, 1 Jul. 1966–30 Jun. 1967

Ralph G. Allen, Jr., William R. Bruce, Kenneth R. Kay, Larry K. Morrison, Robert A. Neish et al Jul. 1967 157 p refs
(Contract AF 41(609)-3099)
(AD-659146)

Chorioretinal burn thresholds for rabbits were determined for 66 various combinations of exposure durations and retinal image diameters. The criterion for burn damage was the appearance of an ophthalmoscopically visible lesion 5 minutes after the flash exposure. Exposure durations ranged from 165 microsec to 100 sec and the range of image diameters was from 0.053 mm to 1.08 mm. The thresholds were based on an average of 9 eyes per condition. Burn thresholds were also determined for rhesus monkeys. Exposure durations from 4 to 250 msec and image diameters from 0.11 to 1.30 mm were employed for the threshold determinations. Fluorescein angiographs were investigated as a means for the detection of chorioretinal damage below the level of the ophthalmoscopically visible lesion. In an area of moderate damage there is rapid fluorescence which was interpreted to be the result of an increase in capillary permeability. A ruby laser was adapted for further studies on chorioretinal burns in rabbits and primates. And a flashblindness testing apparatus for measuring visual recovery times for human subjects was constructed and tested. TAB

N68-10808# School of Aerospace Medicine, Brooks AFB, Tex.

TEMPERATURE-SENSING TELEMETRY SYSTEM FOR UNRESTRAINED RHESUS MONKEYS *(MACACA MULATTA)*

Henry Buchanan, Jere M. Phillips, Alfredo Lopez, and Willis F. Moore Jul. 1967 11 p refs
(SAM-TR-67-63; AD-659365)

The temperature-sensing telemetry system consists of three implanted transmitters (each with its own antenna system and receiver), a scanner to sample in sequence each receiver output, a frequency counter, digital recorder, and tape punch unit. The scanner, synchronized with the digital recorder, permits temperature recording from each of the three transmitters once every 5 minutes. The implant is an FM/FM (frequency-modulated subcarrier/frequency-modulated transmitter) telemetry unit operating in the 88 to 108 MHz broadcast band. Thermistors are used as temperature sensors. Printed circuit boards are used for component interconnection and antenna; mercury batteries are used for power. The sensor, radio frequency transmitter, and batteries are embedded in an epoxy case. Before implantation the unit is calibrated in a water bath over the temperature range of 34 to 42C. The system has been used to automatically record, digitally and continuously, temperature measurements of three unrestrained rhesus monkeys (Macaca mulatta) for a period of 5 weeks. Author (TAB)

N68-10809# School of Aerospace Medicine, Brooks AFB, Tex.

THE EFFECTS OF MONOMETHYLHYDRAZINE UPON RENAL FUNCTION

Frederic L. Coe, Robert W. Howe, and James A. Goetting Jul. 1967 7 p refs
(SAM-TR-67-61; AD-659721)

The toxicology of alkylhydrazine derivatives has been extensively studied by the Air Force because of the use of these compounds in rocket propulsion systems. The present study deals specifically with the effects of monomethylhydrazine (MMH) upon renal function in dogs. The effects of monomethylhydrazine upon renal excretion of sodium, potassium, and water are those of a weakly diuretic agent. When administered intravenously to dogs, it produces modest increases in ion and water excretion unassociated with concomitant increase of glomerular filtration rate. Selective intrarenal infusion does not produce a significant ipsilateral diuresis. The mechanism responsible for the diuretic action of MMH is not known. Author (TAB)

N68-10818# Naval Medical Research Inst., Bethesda, Md.

ELECTRICAL ACTIVITY OF RECEPTORS, ASSOCIATED WITH MAINTENANCE OF FLIGHT, IN THE LOCUST [ELEKTRICHESKAIA AKTIVNOSTI REPSEPTOROV SVIAZANNYKH S PODDERZHANIEM POLETA, U SARANCHI]

V. L. Sviderskii 1967 9 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 172, no. 5, 1967 p 1230–1233
(NMS-TRANS-2036; TT-67-62584; AD-656919)

The studied locust receptors are mechanoreceptors which, by the nature of their response, somewhat resemble certain tactile receptors in the paws of the fly. The essential factor for the activation of the recaptor is the static shifting, and not the vibration of the cilium which occurs during its subjection to blowing of air. These receptors belong in the group of slowly adapting receptors and the final frequency of the order of 50-70 imp/sec, apparently, is adequate for the maintenance of the active state of the system which controls the flight of the insect. Author (TAB)

N68-10834# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.

ADAPTATION TO A HOMOCHROMATIC VISUAL WORLD

Jo Ann S. Kinney and Jane C. Cooper 28 Jul. 1967 13 p refs
(SMRL-499; AD-659496)

In a simulation of the underwater visual world, subjects adapted to a diffuse visual field of blue-green light and, for a control, a field of red light. Measures were then made both of the shift in color appearance of objects and of the subjects speed of reacting to these shifted colors. The amount of change in the appearance of colors was sizable, easily accounting for the reports sometimes made by SEALAB divers, who said they could see yellows and reds when there were none present. There was, however, no change in the subjects speed of reacting to the colors. Author (TAB)

N68-10845# College de France, Paris. Inst. Marey.

NERVOUS PROCESSES UNDERLYING BEHAVIOR AND LEARNING Final Scientific Report, 1 May 1966–30 Apr. 1967

A.-E. Fessard 30 Apr. 1967 15 p refs
(Grant AF-EOAR-66-45)
(AFOSR-67-2272; AD-659549)

Abstracts are presented on the following experiments: Cutaneous nerve fibers involved in a stable defensive reaction; Cortical controls on a stable defensive reaction in cats; Modifications of evoked potentials in thalamus during auditory conditioning in cats; Subcortical structures and learning in rats; Thalamic retention of engrams for a conditioned escape reaction in functionally decorticated rat brains; Brain structures involved in a delayed alternation task in monkeys; Paradoxical phase of sleep and cortico-subcortical controls; Double origin of the inhibition exerted on the extra-lemniscal afferent messages; and Multi-modal projections to the claustrum in the cat brain. TAB

N68-10848 Kernforschungsanlage, Juelich (West Germany). Arbeitsgruppe Institut fuer Zoologie.

LIFE OBSERVATIONS AND ELECTRON MICROSCOPIC INVESTIGATIONS OF THE NEW FORMATION OF MITOCHONDRIA IN CULTURED CHICKEN HEART CELLS [LEBENDBEOBACHTUNGEN UND ELEKTRONENMIKROSKOPISCHE UNTERSUCHUNGEN DER NEUENTSTEHUNG VON MITOCHONDRIAN IN GEZUECHTETEN HUEHNERHERZZELLEN]

Ernst Wendt and Dieter Schaefer Jun. 1967 21 p refs In GERMAN; ENGLISH summary

(JUL-492-ZO) CFSTI: $3.00

In irradiated and unirradiated chicken heart myoblasts cultivated in vitro, the formation of mitochondria was studied by means of phase contrast and electron microscopy. Phase constrast observations of the living object 6 to 7 hours after irradiation with 2400 R found functionally active mitochondria decreased: subsequently there appeared in the cytoplasm numerous small spherical pre-mitochondria which soon increased in number and developed into mitochondria of normal size and structure. Results with the electron microscope showed that the endoplasmic reticulum produced buds considered as young pre-mitochondria. Later on, in limited areas, the spherical pre-mitochondria show the typical arrangement of cristae mitochondriales and simultaneously increase in length. Therewith the pre-mitochondria assume a club-shaped form, the spherical portion of which is filled with a dense ground-substance. This ground-substance obviously produces the material for further formation of cristae mitochondriales which accompanies the outgrowth of the mitochondrial tube. Thus the pre-mitochondria transform into definitive mitochondria. Author

N68-10855*# Battelle Memorial Inst., Columbus, Ohio.

ENGINEERING REQUIREMENTS FOR CULTURING OF HYDROGENOMONAS BACTERIA

John F. Foster and John H. Litchfield [1967] 8 p refs

(Contracts NASr-100(03); NAS2-4270)

(NASA-CR-90111) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Experimental results obtained with a continuous culture system for the cultivation of *Hydrogenomonas eutropha* for waste management in a life-support system indicate that a reliable and stable system can be designed under the present state-of-the-art. The present system provides for control of hydrogen, oxygen, carbon dioxide, pH, cell density, temperature, urea, and ammonia during growth. The culture system design is adaptable to operation in a zero-gravity field, and should be adaptable to integration with proposed water electrolysis and product recovery systems for waste management in an overall life support system. Author

N68-10911 Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Biologie und Landwirtschaft.

ANALYSIS OF n-ACTIVATION AND ITS APPLICATION POSSIBILITIES IN VETERINARY, HUMAN, AND FORENSIC MEDICINE [n-AKTIVIERUNGSANALYSEN UND IHRE ANWENDUNGSMOEGLICHKEITEN IN TIER-, HUMAN- UND GERICHTSMEDIZIN]

H. Altmann 1967 20 p refs In GERMAN Submitted for publication

(SGAE-BL-21/1967) CFSTI: $3.00

Main emphasis in medical activation analytical methods centers on the determination and registration of single trace elements in different organs and cell structures. Changed element concentrations and combinations in pathological processes are easily determined for thyroid functions, liver damage, cancer research, some dental decay problems, etc. Applications of neutron activation analyses in forensic medicine are steadily increasing; arsenic content location in hair establishes time and dosage of poison intake; powder residues on hands and clothing of suspect persons can be identified. Also important are identification analyses for narcotics, traffic accident debris, pesticide poisonings, and various industrial and nuclear research plants. Transl. by G.G.

N68-10914# Kernforschungsanlage, Juelich (West Germany). Zentralbibliothek.

COMPILATION OF LITERATURE ON THE NUCLEAR SCIENCES [LITERATURZUSAMMENSTELLUNGEN AUS DEN GEBIETEN DER KERNWISSENSCHAFTEN]

E. Paul, comp. May 1967 26 p refs In GERMAN

(JUL-BIBL-7) CFSTI: HC $3.00/MF $0.65

This literature survey on nuclear science publications covers the following aspects: biology and medicine, chemistry, technology, radiation shielding and safety, instrumentation, isotope technology, metal, ceramic and other materials, physics, reactor technology, and some general and different subjects. Transl. by G.G.

N68-10993 Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Biologie und Landwirtschaft.

CHANGES IN THE COMPOSITION OF FREE NUCLEOTIDES IN YEAST AFTER GAMMA-IRRADIATION [VERAENDERUNGEN IN DER ZUSAMMENSETZUNG DER FREIEN NUCLEOTIDE IN HEFE NACH GAMMA-BESTRAHLUNG]

G. Stehlik, H. Altmann, and K. Kaindl 1967 17 p refs In GERMAN; ENGLISH summary Submitted for publication Supported in part by Bundesmin. fuer Handel, Gewerbe und Ind.

(SGAE-BL-22/1967)

Saccharomyces cerevisiae var. *ellipsoideus* was gamma-irradiated at a dose of $0.3 \times 10_6$ rad ^{60}Co. $^{32}PO_4^{-3}$ was incorporated at different times after irradiation. The free nucleotides were isolated and separated to determine their metabolism-dependent synthesis, modification or degradation. The most noticeable change was the decrease in adenosine triphosphate (ATP) and the increase in adenosine monophosphate (AMP). The group transferring co-enzymes also showed an alteration. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-10008# Army Behavioral Science Research Lab., Washington, D. C. Support Systems Research Div.

RAPID SCREENING OF TACTICAL IMAGERY AS A FUNCTION OF DISPLAY TIME

James A. Thomas and Robert Sadacca Jun. 1967 30 p

(BESRL-TRN-189; AD-657584)

An experimental study was made to assess the effectiveness of two techniques for rapid screening to select imagery frames of high military potential and to determine the effects of variations in display time on screening performance. Two samples of image interpreters, each consisting of three matched groups, screened three sets of imagery at three different display time intervals (5, 15, and 25 seconds per frame for Sample 1; 10, 20, and 30 seconds per frame for Sample 2). Each interpreter was instructed to perform two screening functions while scanning each print--(1) annotate on the frame all areas of military activity he detected; and (2) assign to each print a priority rating of High, Medium, or Low to indicate estimated intelligence value of the frame. Interpreter performance under the two methods was compared in terms of accuracy and validity of the annotations and priority ratings across the six screening time intervals. Results of the study definitely favored the priority ratings technique over annotation screening.

The ratings, of high accuracy even with short viewing time, improved significantly both in accuracy and in validity with longer display time. Generally, performance was better on the measures which were less complex and showed fewer target areas. Validity of the number of annotations on a frame, generally low, did not vary significantly with display time. More incorrect as well as correct annotations were made, a finding similar to previous BESRL findings for unspeeded interpretation performance. Author (TAB)

N68-10228# Army Behavioral Science Research Lab., Washington, D. C.

IMPACT OF FEEDBACK ON ACCURACY OF CONFIDENCE LEVELS ASSIGNED BY INTERPRETERS

James A. Thomas and Robert Sadacca Jun. 1967 27 p refs

(BESRL-TRN-187; AD-657583)

The study dealt with the utility of feedback presented under simulated computerized conditions in improving the performance of interpreters in judging the value of their own identifications. Results supported previous findings that interpreters do not as a rule make dependable evaluations of their identifications. Confidence ratings made by interpreters in the high performance subgroup were generally more accurate and complete than those made in the low performance subgroup. Two feedback techniques in which the interpreters were given only data on previous rating performance--their own and their own plus that of other classes--resulted in somewhat more accurate expressions of confidence than did the technique in which interpreters were given their own corrected reports and the imagery they had previously interpreted. Confidence ratings reported by the interpreter group receiving no feedback were the least precise. It was concluded that interpreters confidence ratings can be improved by practice in applying a knowledge-of-results frame of reference. Findings suggest, however, that more than two practice sessions are needed for the interpreter to reach an operationally useful level of accuracy in evaluating the information he provides. Author (TAB)

N68-10250*# American Inst. of Biological Sciences, Washington, D. C. Bioinstrumentation Advisory Council.

SOME NOTES ON THE PROBLEM OF UNCERTAINTY IN BIOLOGICAL MEASUREMENTS

Harold J. Morowitz (Yale Univ.) 1 Mar. 1966 9 p

(Contracts NASr-132; Nonr-4526(04))

(NASA-CR-90063; BIAC-M6) CFSTI: HC $3.00/MF $0.65 CSCL 06B

A synthesis of two previously published articles on the problems of measurement and instrumentation in biology is presented. Among the problems discussed are the large number of independent variables, uncertainty on the micro and macro levels, the possibility that the measurement process may act as a stimulus causing changes in the object, and instrument design. Approaches to the problems are outlined, and the uncertainty aspect is emphasized. N.E.N.

N68-10272# N. Y. Air Development Center, Griffiss AFB, N. Y. Display Techniques Branch.

DICHROIC FILTER SPECIFICATION FOR COLOR ADDITIVE DISPLAYS. II: FURTHER EXPLORATION OF TOLERANCE AREAS AND THE INFLUENCE OF OTHER DISPLAY VARIABLES Final Technical Report

Edward F. Rizy Sep. 1967 59 p refs

(RADC-TR-67-513; AD-659346)

Specification of primaries for seven-color display generation was examined under a wide range of contions, including modifications to the equipment, manipulation of environmental variables, and control of response variables. The basic purpose of this series of studies was to increase the precision of previously determined specifications for dichroic filters to be employed in additive multicolored large-scale displays. The upper tolerance limit for the blue dichroic filter was determined to a high degree of precision. In addition, questions of filter order, character size, and brightness contrast were examined experimentally to determine their influence on filter specification. As a summary contribution, an ideal seven-color additive system is outlined. Finally, recommendations are provided for situations wherein physical restrictions militate against the employment of the full seven color system approach. Author (TAB)

N68-10339* American Inst. of Biological Sciences, Washington, D. C. Bioinstrumentation Advisory Council.

A STUDY OF POWER AND FREQUENCY REQUIREMENTS IN BIO-TELEMETRY

Frank J. Haahn 1 Jan. 1966 26 p

(Contracts NASr-132; Nonr-4526(04))

(NASA-CR-90064; BIAC-M2) CSCL 06B

The role of the Federal Communications Commission (FCC) in supervising and controlling the use of the electromagnetic spectrum is reviewed, as a prelude to discussing that portion of the biotelemetric technique which uses electromagnetic waves for transmitting measurement and control information. The impact of biotelemetric research on the life sciences is stressed, and its historical development is traced. The needs of biotelemetry and the rules of the FCC are examined in relation to the obvious conflict which exists. The detailed situations created by each different kind of biological application of telemetry are categorized as: local, confined radiation; local, unrestricted radiation; local, extended range radiation; area; regional; continental; international; and extraterrestrial. The lack of permissiveness towards telemetry in the FCC rules is pointed out, and the power and frequency requirements of biotelemetry are stated. A recommendation is made that the FCC be petitioned for a change in rule to permit biotelemetric transmissions under certain specified conditions and combinations of conditions. M.G.J.

N68-10356* American Inst. of Biological Sciences, Washington, D. C. Bioinstrumentation Advisory Council.

A SPECIAL REPORT ON BIO-TELEMETRY

Feb. 1965 45 p refs Repr.

(Contracts NASr-132; Nonr-4526(04))

(NASA-CR-90066; BIAC-M1) CSCL 06B

Several facets of biotelemetry are discussed in the context of the necessary collaboration between biologists and engineers. The potentialities of ecological biotelemetry are reviewed, worldwide active projects are surveyed, and an extensive bibliography on the subject is included. Field studies and experiments are reported on avian navigation, tracking grizzly bears, ruffed grouse behavior, and marine biotelemetry. Documented data are presented on the use of an advanced biotelemetering system to monitor the movement and behavior of wildlife under natural conditions. The automatic radio tracking system used is described, and the problems of data interpretation are considered. Technological developments are examined in relation to designing systems for the field and for physiological data; transmitter range and life predictions; and microelectronics and miniaturization. M.G.J.

N68-10381*# Serendipity Associates, Chatsworth, Calif.

A DESCRIPTIVE MODEL FOR DETERMINING OPTIMAL HUMAN PERFORMANCE IN SYSTEMS, VOLUME 4 Final Summary Report

Washington NASA Nov. 1967 51 p

(Contract NAS2-2955) CSCL 05H

(NASA-CR-879) CFSTI: HC $3.00/MF $0.65

This study was conducted to provide tools to aid in management decisions germane to the development of complex

aerospace systems to the end that man be used in an optimal way. The study consists of five parts packaged in three reports and each part is focused on a particular area of concern to enable the necessary decision making, planning, and execution effort to be conducted. The reports are concerned with a simple model of a man–machine development cycle, a simple calculus for discrete systems, system development activities concerned with putting man in an aerospace system, some concepts and guidelines for developing man–machine systems, and an approach for determining the optimal role of man and allocation of functions in an aerospace system. The method by which the study was conducted is described in terms of 12 major tasks. Implications for future work are considered in detail. R.N.A.

N68-10395*# Miami Valley Hospital, Dayton, Ohio.
EFFECTS OF MINIMAL PERSONAL HYGIENE AND RELATED PROCEDURES DURING PROLONGED CONFINEMENT
A. R. Slonim Wright-Patterson AFB, Ohio AMRL Oct. 1966 32 p refs Prepared jointly with Fairchild Hiller Corp.
(NASA Order R-85; Contracts AF 33(657)-11716; AF 33(615)-1814)
(NASA-CR-90113; AMRL-TR-66-146; AD-659142) CSCL 06N

Thirty-six healthy male subjects were studied under closely confined conditions in nine 6-week experiments over a 2-year period. The effects of minimal personal hygiene and related procedures were evaluated. No major problems resulted from the lack of bathing, sponging the body, changing clothes and bedding. Body odor, strongest in axilla, groin, and feet, heightened in 7-10 days inside the AMRL Evaluator, but subsided in the second week. The absence of shaving and hair and nail grooming resulted in 25% of the subjects having to trim their mustache, 50% having to trim their fingernails at or after the fourth week, and dandruff and scalp itchiness in almost all cases. Of all restricted hygenic procedures, the use of substandard oral hygiene produced the greatest clinical effect, with all 20 subjects tested developing varying degrees of gingivitis. Limited hygiene during exposure to two 32 C periods produced no major but a number of minor problems associated with much dryness of skin and scalp. The types of microorganisms recovered from subject and environment as well as their characteristic buildup and spread over certain body areas under these minimal hygiene conditions are reviewed. Prolonged wearing of full pressure suits was well tolerated in most cases. Constant wearing of bioinstrumentation electrodes attached to the skin irritated all subjects tested. Seven different oral hygiene procedures and the efficacy of various waste management items, including different chemically-saturated wipes and fecal collectors, were evaluated. Author (TAB)

N68-10515# Cornell Univ., Ithaca, N. Y.
LENGTHS OF CYCLE TIMES IN RANDOM NEURAL NETWORKS
Neil James Alexander Sloane 15 Feb. 1967 173 p refs
(Contract Nonr-401(40); Grant NSF GP-971)
(Rept.-10; AD-659508)

The report contains a feasibility study of timing circuits for a model of the human brain. It is shown that certain random neural networks have cycle times which increase exponentially with the size of the network, and that these networks may be used as timing devices even for a period of time equal to a human lifetime. The methods used in this report are those of probability, combinatorial analysis, and number theory. Author (TAB)

N68-10535*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Control Lab.
STUDIES OF HUMAN DYNAMIC SPACE ORIENTATION USING TECHNIQUES OF CONTROL THEORY
L. R. Young and Y. T. Li Jun. 1967 35 p refs
(Grant NsG-577)
(NASA-CR-89978; SASR-7) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Results for a series of man-vehicle control laboratory studies are summarized. Progress in developing a three-dimensional display system is discussed in detail. Preliminary experiments were conducted and a prototype three dimensional contact analog system was constructed in which the non-stereoscopic deflection and non-deflection depth cues alone were incorporated. The system consists of a computer generated CRT display of a cube, presented in perspective, with inverse square law line intensification. The cube appears as a solid object, as all lines leading to hidden vertices are blanked. The display operates continuously, showing an updated scene thirty-two times per second. The pilot has full six degree of freedom control over the scene through simulated vehicle dynamics. Development status for an ultrasonic head position sensor for tracking the pilot's head motion is also discussed. E.C.

N68-10548# De Havilland Aircraft Co., Ltd., Malton (Ontario). Special Products and Applied Research Div.
BOOM ATTACHMENT SYSTEM Final Technical Report, 20 Jul. 1966–13 Sep. 1966
J. F. Haines, A. T. Woodford, B. Abbott et al Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. Aug. 1967 87 p
(Contract AF 33(615)-2724)
(AFAPL-TR-67-14; AD-659450)

The low gravity field environment experienced in space presents problems to astronauts attempting to perform work outside their spacecraft. This problem can be defined in part as the difficulty to maneuver and the difficulty to keep station relative to a surface on which work is being carried out. This is mainly due to the greatly reduced restraining forces available to a space worker, particularly the lack of friction force as a result of body weight reaction. To become effective in space, man must develop means of controlling reactions to work loads. Means have been studied to overcome this problem by restraint devices such as handholds, belts, and harnesses. Another means, and that which this report describes, is attachment to a work surface by rigid booms. A rigid boom attachment system offers a worker the advantage of being able to neglect the effect of moderate work loads. Design and development of an evaluation model of such a system using unfurlable booms—an application of de Havillands patented STEM (Storable Tubular Extendible Member) principle—was carried out by de Havilland along guide lines laid by the United States Air Force and within the restrictions of a limited budget. The developed system should prove of great use in narrowing the guide lines to an optimum system. Author (TAB)

N68-10620*# Midwest Research Inst., Kansas City, Mo.
MEDICAL APPLICATIONS OF AEROSPACE SCIENCE AND TECHNOLOGY Quarterly Report, 1 Aug.–31 Oct. 1967
16 Nov. 1967 58 p refs
(Contract NASr-63(13); MRI Proj. 3077-E)
(NASA-CR-90026; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Work efforts were conducted on (1) the successful application of NASA spray electrodes to the recording of electrocardiograms on children undergoing exercises; (2) the measurement of oxygen and carbon dioxide during respiration; (3) a photographic technique for body cavities; (4) an impedance cardiograph system, (5) a blood pressure measuring system, and (6) a chronic intracranial pressure measurement procedure. Measurements of tremors and muscle reflexes; cranial nerve potentials; bone distortion; microcirculation; muscle heat; temporomandibular joint action; brain waves; eyeblink; body motion; infant motor activity; and electric field effects on living cells, were also made. Other miscellaneous activities concerning medical problems are also described. L.S.

N68-10648* Aerospace Products Research Corp., Santa Monica, Calif.

COMPUTER DRIVEN ELECTROLUMINESCENT VERTICAL SCALE INDICATOR

James A. Pellegrino and Jules L. Rosenbaum Washington NASA Nov. 1967 40 p

(Contract NAS7-420)

(NASA-CR-919) CFSTI: $3.00 CSCL 09B

The effort expended in the design, development, and fabrication of two types of solid-state digitally controlled electroluminescent vertical scale indicators is outlined. One type is a single parameter indicator which employs one bargraph, with scale and parameter indication; and the other is a flight director which uses two adjacent bargraphs, with scale and parameter indication. The delivered indicators met all of the following specification requirements: fast dynamic response compatible with the SDS 920 Computer update-time capability of one to twenty milliseconds; automatic lamp brightness regulation; absence of glow, flicker, and cross-coupling in the lighted display; use of high-contrast display techniques; interchangeability and versatility compatibile with an instrument used in laboratory simulations; multicolor display capability; internal information storage; low power consumption, capable of operating at 2.5 watts. The objectives for simulator environments were met with the exception of temperature. Some difficulty was encountered in isolating problems which appeared under dynamic operation of the instruments. Author

N68-10696 Joint Publications Research Service, Washington, D. C.

WIDE APPLICATION OF BIONICS OUTLINED

V. V. Parin 24 Nov. 1967 11 p Transl. into ENGLISH from Morskoi Sb. (Moscow), no. 9, 1965 p 32–37

(JPRS-43439) CFSTI: $3.00

An historical note deals with the application of bionics to other scientific disciplines, and research in biology is considered as a guideline for channeling allied research activities. Cybernetics is referred to as ushering in a new period in the development of science, wherein there has begun a synthesis of the various branches of knowledge. Presently, bionics is in its infancy, with efforts directed at systematization and consolidation of efforts toward solving engineering problems. Mention is made of computer applications and the wide range of problems that lend themselves to bionics research. M.W.R.

N68-10734# RAND Corp., Santa Monica, Calif.

AIRCREW RATIO STUDIES

A. J. Gross Sep. 1967 51 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5385-PR; AD-659132)

The memorandum describes a probabilistic model that can be used both as a planning factor and as an evaluation procedure in allocating aircrews to squadrons. Ordinarily, aircrew ratios are determined from prior experience such as number of scheduled flying hours per crew, average number of missions per day, and average number of aircraft per mission. These factors are incorporated with the time allocation of aircrew personnel to various tasks, including flying, to derive an aircrew ratio for a squadron during a flying period. The probability model utilized the above factors as primary inputs. The outputs are graphs showing the probability that a particular squadron meets a required mission objective as a function of the crew ratio. The model is also used to measure the effect of a constant aircrew ratio as the number of aircraft per mission is varied. In essence, by applying the model one is able to determine the probability that a squadron of k planes will simultaneously fly a given mission if there are k + s crews available to fly it; i.e., if the crew ratio is (1 + s/k). Author (TAB)

N68-10776# Human Engineering Labs., Aberdeen Proving Ground, Md.

A BEHAVIORAL STUDY OF THE SOUND-SHADOW EFFECT IN IMPULSE NOISE

Davod C. Hodge and R. Bruce McCommons Jul. 1967 23 p refs

(TM-12-67; AD-659331)

The sound-shadow effect of the human head in an impulse-noise field was studied by exposing 27 subjects to gunfire noise so their left ears were normal to the oncoming shock wave (near ear) and their right ears were protected by the shadow of the head (far ear). Noise exposure was continued until the subjects near ear demonstrated 15 dB temporary threshold shift (TTS) and the post-exposure TTS in near and far ears was compared. Peak pressure level at the entrance of the far ear canal was less than one-half that found at the near ear (153 vs. 161 dB re 0.0002 microbar). Mean TTS was significantly smaller in the far ears than it was in the near ears. The mean protection afforded the far ear by the heads shadow ranged from three dB at 1 kHz to 12 dB at 6 kHz. The implications of the findings for the protection of weapon crewmen are discussed. Author (TAB)

N68-10810# School of Aerospace Medicine, Brooks AFB, Tex.

F-106B AIRCRAFT FLASHBLINDNESS EXPERIMENT

Albert V. Alder and James E. Hamilton Jul. 1967 7 p refs

(SAM-TR-67-41; AD-659718)

A study was conducted to obtain quantitative performance data from the effect of flashblindness upon aircraft control and to measure the visual recovery time from flashblindness during a series of flights in the F-106B aircraft. A Stroboner 65c flashlamp was mounted in the rear cockpit of the aircraft beneath a lightproof, buggy-top canopy in order to produce flashblindness under simulated nighttime conditions. Aircraft attitude and recovery time were monitored by the safety pilot, two cameras, and the aircrafts tactical airborne recording package. The effect of flashblindness on aircraft control and recovery time for flashblindness are discussed in relation to similar previous studies performed in aircraft simulators. Author (TAB)

N68-10825# Human Engineering Labs., Aberdeen Proving Ground, Md.

GROWTH OF TEMPORARY THRESHOLD SHIFT FROM IMPULSE NOISE: A METHODOLOGICAL STUDY

David C. Hodge and R. Bruce McCommons May 1967 39 p refs

(TM-10-67; AD-659330)

An experiment was performed (a) to validate a procedure for determining the growth rate of temporary threshold shift (TTS) from impulse-noise exposure and examine the range of TTS growth rates occurring in a sample representative of the Army population; and (b) to see how binaural and monaural impulse-noise exposure differ in their effect on TTS growth rate. Thirty-nine subjects were exposed to 155 db peak-level gunfire impulses until they demonstrated 15 db TTS2 at 2, 4, or 6 KHz. The results showed that (a) fewer impulses should be administered at the beginning of a test session to better estimate the shape of the TTS growth function; and (b) binaural exposure to impulse noise, under the conditions employed in this study, did not result in consistently faster or slower rates of TTS growth than monaural noise exposure. Author (TAB)

N68-10830# FMC Corp., Santa Clara, Calif.

DEVELOPMENT OF A GENERAL PREDICTION METHOD FOR TRANSCRIPTION ERROR RATE Technical Report, 15 Jan.–30 Jun. 1967

Richard L. Hawley, Anne Melby, and Bruce N. McArthur Wright-Patterson AFB, Ohio ASD Jun. 1967 108 p refs
(Contract F33615-67-C-1361)
(R-2595; ASD-TR-67-7; AD-659449)

This study develops a General Prediction Method (GPM) for estimating the human error rate in a data transcription system. It also indicates the nature of the relationships between error rate and the significant determinants, and it specifies the relative importance of these relationships. Correlation and stepwise regression analyses are performed on data gathered in previous laboratory experiments in obtaining the desired results. The following factors are investigated for their influence on human error rate: Operator Age, Education, and Occupation; Transcription Methods; Code Length, Content, Mix, and Repetition; Code Blocking and Order; Grouping within Codes; Response Format; and Duration of Work Period. The following factors have the greatest influence: Code Length, Content, Transcription Method, and Repetition. The following have less influence: Sex, Age, Occupation, Duration of Work Period, Response Format, Education, Grouping within Codes, Code Blocking and Order. It is recommended that the GPM be validated by application to operational data systems and refinement made in operational settings where those factors found relatively unimportant in this study would be eliminated enabling easier application of the GPM. Author (TAB)

N68-10881# Army Missile Command, Huntsville, Ala.
TOLERANCE PHILOSOPHY
William E. Keeling Jun. 1967 40 p
(AD-816406) CFSTI: HC $3.00/MF $0.65

The report is designed to establish the interdependency of test equipment tolerance limits to other parameters of system design and to establish a general tolerance philosophy. Included is a graphical development of tolerance philosophy and a derivation of applicable tolerance handling formulas. The central theme of the report proves that test equipment tolerance is a dependent function of a parameter called delta sigma and is basically unrelated to the item under test tolerance. This theme is then expanded to include other elements necessary to establish an overall tolerance philosophy for use by the Government, contractors, and designers. Also included are some of the relationships of mathematical tolerance manipulation to the laws of distribution probability, particularly as they relate to the incorrect presumptions currently employed. Author (TAB)

N68-10988# Sandia Corp., Albuquerque, N. Mex.
USE OF RESPIRATORS AND METHODS OF DETERMINING FACE FIT
A. Juskiewicz and C. P. Skillern Aug. 1967 11 p
(SC-RR-67-461) CFSTI: HC $3.00/MF $0.65

The methods that are used for determining face fit for respiratory protective devices at Sandia Laboratory are described. Individuals are tested, after their threshold for amyl acetate has been determined, in a room containing a known concentration of amyl acetate. The penetration between the mask and the face is determined by using this information. The criteria for mask issue are given with cleaning and maintenance procedures. Author (NSA)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-10041# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THE MOLECULAR STRUCTURE OF URANIUM HEXAFLUORIDE [CONTRIBUTION A L'ETUDE DE LA STRUCTURE MOLECULAIRE DE L'HEXAFLUORURE D'URANIUM]
Roland Bougon (Ph.D. Thesis) Jun. 1967 106 p refs In FRENCH
(CEA-R-3235)

The vibrational spectrum of uranium hexafluoride has been studied in both the gaseous and solid states. The study of gaseous UF_6 confirmed the regular octahedral structure of the fluorine atoms around the central U atom and made it possible to evaluate some of the vibrational frequencies. From these, some new force constants have been determined. A tetragonal distortion was observed on solid UF_6. Author (NSA)

N68-10095*# Rocketdyne, Canoga Park, Calif.
PROPERTIES OF NONAQUEOUS ELECTROLYTES Quarterly Report, 20 Jun.–19 Sep. 1967
Rudolf Keller, James N. Foster, John F. Hon, Otto F. Kalman, and Jack M. Sullivan 19 Oct. 1967 64 p refs
(Contract NAS3-8521)
(NASA-CR-72324; R-6754-5) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Studies of aprotic electrolytes based on three solvents: propylene carbonate, dimethyl formamide, and acetonitrile, were continued. Characterized components were used to prepare the electrolyte solutions. Structural studies of electrolytes containing lithium perchlorate, lithium chloride, aluminum chloride, and cupric chloride were performed by nuclear magnetic resonance. The physical properties measured included solvent viscosities, electrolyte conductances to determine individual ion mobilities, sonic velocities, and transference numbers. Author

N68-10212 Ministry of Technology, Orpington (England). Technical Information and Library Services.
STUDIES ON THE NITRATION OF UREA DERIVATIVES. 2: THE NITRATION PRODUCT OF MONOMETHYL UREA
Kazno Shuno and Senzo Oinuma Sep. 1967 15 p refs Transl. into ENGLISH from Rep. Gov. Chem. Industr. Res. Inst. (Tokyo), v. 59, no. 12, 1964 p 354–542
(TIL/T-5722)

The preparation of an explosive compound from monomethyl urea by treatment with nitric acid and acetic anhydride is described. Characteristics of the product are given. It appears to be methyl dinitro amine. According to the Trauzl lead block test the explosive power is greater than that of most single ingredient explosives. Author

N68-10254# California Univ., Livermore. Lawrence Radiation Lab.
AMMONOLYSIS OF URANIUM HALIDES. I: AMMONOLYSIS OF URANIUM TETRACHLORIDE AND TETRABROMIDE
W. Burk and E. Naumann Mar. 1967 20 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 344, 1966 p 306–315
(UCRL-Trans-10097) CFSTI: HC $3.00/MF $0.65

The reactions of UCl_4 and UBr_4 with ammonia, which was investigated between 20 and 700°C, led to the formation of ammoniates, amidohalides, imidohalides, and nitridohalides and nitrides of uranium according to the reaction temperature. Author (NSA)

N68-10255# California Univ., Livermore. Lawrence Radiation Lab.

NONDISPERSIVE ANALYSIS OF X-RAY FLUORESCENCE EXCITED BY RADIOISOTOPE SOURCES AND ITS APPLICATIONS

Barbara Holynska Apr. 1967 39 p refs Transl. into ENGLISH from Chem. Anal. (Warsaw), v. 11, 1966 p 647–664
(UCRL-Trans-10102) CFSTI: HC$3.00/MF$0.65

The principles and applications of nondispersive X-ray fluorescence analysis excited by radioisotope sources are reviewed. The most commonly applied radioisotope sources, the methods applied for the measurement of the energy and intensity of the radiations, and typical measurement geometries are considered. Special attention is given to the matrix effect as the basic factor decreasing the accuracy of the method. Several methods proposed for elimination of the matrix effect are discussed. Papers describing application of the X-ray fluorescence analysis for industrial analytical problems are reviewed. The methods of determination of various elements in alloys, ores, concentrates, and other materials are described. Author (NSA)

N68-10262# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

VAPOR PRESSURE IN THE SYSTEMS $MeCl_2$–HCl–H_2O. 2. THE SYSTEM $CaCl_2$–HCl–H_2O

L. S. Lilich and M. D. Anikiyeva Oct. 1967 12 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 22, 1956 p 97–103
(PA-TT-60; TT-67-62993; AD-659337)

The partial vapor pressure of water and hydrochloric acid over the ternary system CaCl2-HCl-H2O was investigated at t = 25C. It is established that calcium chloride produced a salting-out effect on the hydrochloric acid present in the solution. Isotherm-isobars of water and hydrochloric acid at t = 25C are plotted. Author (TAB)

N68-10264*# Tyco Labs., Inc., Waltham, Mass.

DEVELOPMENT OF CATHODIC ELECTROCATALYSTS FOR USE IN LOW TEMPERATURE H_2/O_2 FUEL CELLS WITH AN ALKALINE ELECTROLYTE Quarterly Report, Jul. 1, 1965–Jun. 30, 1967

J. Giner, J. Parry, L. Swette, and R. Cattabriga 30 Jun. 1967 215 p refs
(Contract NASw-1233)
(NASA-CR-89925; QR-8) CFSTI: $3.00 CSCL 07D

The purpose of this program is to develop an improved oxygen electrode for use in alkaline H_2/O_2 fuel cells. A survey was made of the intrinsic activity of transition metals, selected transition metal alloys, intermetallic compounds, and transition metal carbides, nitrides, borides, and silicides for the electrochemical reduction of oxygen. Materials shown to be of interest in the initial survey were studied in greater detail. These materials included gold alloys of the precious metals, intermetallic compounds of gold and titanium, nonstoichiometric TiO_2, silver magnesium alloys, Os and Pt/Os alloys, silicon carbide, and barium tantalate. Measurements made on finely divided interstitial compounds of group VIII metals prepared by the Bureau of Mines are also described. Summarized data obtained in the studies are presented in tables. K.W.

N68-10290# Yale Univ., New Haven, Conn.

REACTIONS OF HOT TRITIUM ATOMS WITH METHANE AND HYDROGEN

David Allan Seewald (Ph.D. Thesis) 1967 119 p refs
(Yale-1957-111) CFSTI: HC$3.00/MF$0.65

The reaction of recoil tritium with methane was examined in a search for limitations of the recoil technique. Previously noted discrepancies in hot HT yields at high moderation were traced to the use of helium as a moderator. Reactions of hot tritium with H_2, D_2, and HD were studied. It was found that tritium preferentially reacted with hydrogen when reacting with an equimolar deuterium–hydrogen mixture, while reaction with deuterium was favored in the reaction of tritium with HD. Reactivity integrals and energy loss parameters were evaluated. Ratios of the values obtained for the $T+D_2$ and $T+CH_4$ reactions are in agreement with the corresponding ratios as independently derived from studies of the $T+(CH_4-D_2)$ system. Ratios of α values obtained are compared with theoretical values predicted by both soft-sphere and hard-sphere elastic collision models. Reactivity integrals for hydrogen are compared with corresponding quantities for $T+H_2$ and $T+D_2$. Author (NSA)

N68-10298* Union Carbide Corp., Parma, Ohio. Fuel Cell Dept.

TEST AND EVALUATION OF FUEL CELL CATALYSTS Quarterly Report, Feb. 1–Apr. 30, 1967

G. E. Evans and M. B. Clark 30 Apr. 1967 12 p
(Contract NASw-1524)
(NASA-CR-90065; Q-1) CSCL 07D

The objective of the present program is to determine whether any of the catalyst samples prepared by the Pittsburgh Coal Research Center for NASA are useful as cathodic catalysts in hydrazine-air fuel cells employing alkaline electrolytes. Two screening procedures are being employed. The effect of the catalyst in decomposing hydrazine has been measured. A possible side benefit of this study might be the identification of a catalyst which is highly effective in promoting hydrazine decomposition. In a second set of experiments the potential of oxygen cathodes employing the various catalyst materials is measured in alkaline solutions containing hydrazine. Author

N68-10336* Scientific Translation Service, La Canada, Calif.

SPECTROPHOTOMETRIC DETERMINATION OF PLATINUM (IV) BY SOLVENT EXTRACTION WITH 1, 10-PHENANTHROLINE–IRON (II) CHELATE

Yuroku Yamamoto, Masahiro Tsubouchi, Ichizo Okimura, and Toshiharu Takagi Washington NASA Nov. 1967 8 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi (Tokyo), v. 88, no. 7, 1967 p 745–749
(Contract NASw-1498)
(NASA-TT-F-11380) CSCL 07C

For the spectrophotometric determination of platinum, a trace quantity of platinum is extracted into nitro-benzene. A constant extraction is obtained for a large pH range. Author

N68-10341# Western Reserve Univ., Cleveland, Ohio. Dept. of Chemistry.

STUDIES IN RADIATION CHEMISTRY Final Report

Hugh A. Gillis 31 May 1967 29 p refs
(Contract AT(11-1)-1273)
(COO-1273-4) CFSTI: HC$3.00/MF$0.65

In order to understand the role of reactive solutes used in the radiation chemistry of liquids, a study was made using ethane as solvent. The yields of the major products in the gamma radiolysis of pure ethane (hydrogen, methane, acetylene, ethylene, propane, and n-butane) were in reasonably good agreement with previous values. Thirteen other products with a total G of about 0.16, ranging from propylene to octane, were identified. From results of the irradiation of solutions of C_2D_6 in C_2H_6 and C_2D_4 in C_2H_6 it seems clear that thermal hydrogen atoms are produced in the radiolysis of liquid ethane and that they are scavenged by added or radiolytically generated ethylene. The effects of oxygen and nitrous oxide on the main product yields in irradiation of ethane solutions were studied. NSA

N68-10353# Virginia Univ., Charlottesville. Dept. of Chemistry.
CARBORANE FORMATION FROM ALKYNES AND BORANES. II: SLOW REACTIONS OF B_4H_{10} AND B_5H_{11} WITH ACETYLENE, METHYLACETYLENE AND DIMETHYLACETYLENE
Russell N. Grimes, Christopher L. Bramlett, and R. Leonard Vance Oct. 1967 23 p refs Submitted for publication
(Contract Nonr-474(13))
(TR-3; AD-659319)

It was previously reported (J. Am. Chem. Soc. v89 p2557 1967) that the gas-phase interaction between tetraborane (10) and acetylene, takes place explosively at 100C to give volatile closo-carboranes, and at 25 to 50C proceeds slowly to form derivatives of the nido-carborane C3B3H7 in small yields. In an effort to better understand the general nature of the slow reactions, especially the formation of carborane cage systems, a detailed examination was made of the gas-phase reactions of B4H10 and B5H11 with several small alkynes. Since both B4H10 and B5H11 react with alkynes at room temperature the results of these studies, added to available data on other borane-alkyne systems, give some new indications of the role of borane structural features in reactions of this type. The extreme sensitivity of gas chromatography, coupled with mass spectroscopic, infrared, and nmr techniques, permitted the isolation and structural characterization of virtually all volatile products. TAB

N68-10361# Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.
RADIATION RESEARCH LABORATORIES Quarterly Report, Apr. 1–Jun. 30, 1967
30 Jun. 1967 22 p refs *Its* Fundamental Res. No. 6041
(Contract AT(30-1)-2310)
(RRL-2310-208) CFSTI: HC$3.00/MF$0.65

Research progress is reported on: EPR-transient radicals in aqueous solutions, pulse radiolysis studies of the reaction of OH radicals with nitromethane, pulse radiolytic studies of oxygen-containing transients, photochemical determination of relative rate constants for hydroxyl radical and solvated electron reactions, electron scavenging in irradiated cyclohexane solutions, effect of temperature and phase on ratios of disproportionation to combination of alkyl radicals, pressure dependence of $G(N_2)$ from propane–nitrous oxide mixtures, radioinduced hydroxylation of anisole in dilute aqueous solution, hydrolysis of nitrosubstituted aryl sulfates, Meisenheimer complexes, $Hg(^1P_1)$-photosensitized reactions, mass spectrometric studies of discharge phenomena, formation of phenol in irradiated N_2O–C_6H_6 solutions, theoretical studies of the structure of the PF_4 radical, calculations of ESR spectra, and of ^{18}O isotopic dilution studies in biological systems. Author (NSA)

N68-10376# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
CARBORANE POLYBENZIMIDAZOLES
M. B. Sheratte Apr. 1967 29 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SCL-CR-68-72) CFSTI: HC$3.00/MF$0.65

Two unsuccessful approaches were made to the preparation of polybenzimidazoles with a carborane or neo-carborane cage in the main chain. During the first attempt, neo-carborane-C,C'-dicarboxylic acid diphenyl ester was prepared, and an effort was made to condense this diester with tetraminobiphenyl under various conditions. All experiments conducted during this phase of the program failed, because it was found that the neo-carborane cage is more susceptible to nucleophilic attack than is the carbonyl carbon atom of the ester. This phase of the investigation was then abandoned, and an attempt was made to prepare 3,6-diphenyl-carborane-C,C'-dicarboxylic acid, and to proceed to polymer from this acid. This acid was chosen because it is known that 3,6-diphenyl carborane is not susceptible to nucleophilic attack. However, attempts to dilithiate 3,6-diphenyl carborane led to only a mono-carboxylic acid under the conditions tried. Author (NSA)

N68-10388# California Univ., Berkeley. Lawrence Radiation Lab.
EFFECT OF PRESSURE ON HIGH-TEMPERATURE DISSOLUTION
Mark A. Stett and R. M. Fulrath Feb. 1967 20 p refs Presented at the Intern. Symp. on Kinet. of Reactions in Ionic Systems, Alfred, N. Y., 18–23 Jun. 1967
(Contract W-7405-ENG-48)
(UCRL-17410; CONF-670625-2) CFSTI: HC$3.00/MF$0.65

The effect of pressure on high temperature dissolution was investigated. Solubility of NiO in $Na_2O{\cdot}2SiO_2$ glass was found to decrease with applied pressure, indicating that the entry rate of atoms from a solute into a solvent is decreased by increased pressure. The saturation concentration as measured with the electron beam microprobe was an accurate measurement of the liquidus concentration for a given temperature. Author (NSA)

N68-10404# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
REPROCESSING OF IRRADIATED FUELS Quarterly Report, Jan. 1–Mar. 31, 1967
31 Mar. 1967 21 p
(Contracts EURATOM-006-65-7-RCIB (RD); EURATOM-016-65-1-RAP-B)
(EURAEC-1868; EUR-3372; QR-28) CFSTI: HC$3.00/MF$0.65

Work was continued on evaluating the potential of chlorine fluorides for reprocessing of mixed oxide fuel. Thermodynamic research provided estimates of plutonium hexafluoride concentrations that should prove stable in the presence of the reagents in question. A number of tests on the chemical decanning of stainless steel with the HF–O_2 mixture were carried out. This operation requires satisfactory control of the reaction temperature. Fluid-bed tests were effected: pure uranium dioxide was atomized with oxygen, and the resulting uranium octoxide was hydrofluorinated (4 kg scale). At the same time, similar tests were carried out in a small fluid bed on plutonium mixtures. These reactions were followed by fluorination with chlorine monofluoride. Work continued on constructing the plant for reprocessing research (cold subassembly processing unit, hot thermobalance, hot semipilot). Author (NSA)

N68-10405# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-TEMPERATURE PHASE EQUILIBRIA IN THE LEAD TITANATE–LEAD ZIRCONATE SYSTEM
Ronald L. Moon (Ph.D. Thesis) May 1967 85 p refs
(Contract W-7405-ENG-48)
(UCRL-17545) CFSTI: HC$3.00/MF$0.65

Phase relations at elevated temperatures in the lead titanate–lead zirconate system were investigated by vapor loss, X-ray, thermal and differential thermal analyses. A solid solution is shown to exist in the region between the Curie and solidus temperatures. Experiments in the solid solution region conducted in vacuum at 1050 and 1100°C showed that vaporization of lead oxide results in the formation of a depletion layer at the sample's surface. The depletion layer is deficient in lead oxide and new phases appear as a consequence of this compositional change. The lowest temperature at which liquid is formed in this system, the melting point of lead titanate, was determined to be 1286±3°C. Increasing the lead zirconate to lead titanate ratio increased the solidus temperature. The highest temperature, the melting point of lead zirconate, could be determined because of rapid crucible attack by the sample above 1500°C. At 1360°C a peritectic reaction occurs for compositions between 15 to approximately 40 mole % $PbZrO_3$. Above the peritectic temperature is a three phase region with liquid, zirconia and lead zirconate titanate solid solution in equilibrium. Compositions richer in $PbZrO_3$ than 40 mole % decompose directly to three phases at three phases at the solidus temperatures. The

existence of the three phase region demonstrates that the lead titanate–lead zirconate system is not a true binary, but a subsection of the $PbO–TiO_2–ZrO_2$ ternary system. Author (NSA)

N68-10419*# Scientific Translation Service, La Canada, Calif.
SPECTROPHOTOMETRIC DETERMINATION OF BORON IN ROCKS BY EXTRACTION WITH METHYLENE BLUE TETRA FLUOROBORATE COMPLEX
Akinori Isozaki and Satori Utsumi Washington NASA Nov. 1967 8 p refs Transl. into ENGLISH from Nippon Kaguku Zasshi (Tokyo), v. 88, no. 7, 1967 p 741–744
(Contract NASw-1496)
(NASA-TT-F-11381) CFSTI: HC $3.00/MF $0.65 CSCL 07B

A standard procedure for determining boron in rocks using acids is described. Methylene blue tetrafuoroborate complex can be extracted with dichloroethane. Based on this finding, studies were made to establish a rapid method for the determination of minute quantities of boron in rocks. Author

N68-10433# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
MECHANISMS OF SORPTION OF MOLECULAR IODINE
R. J. Davis Aug. 1967 31 p refs
(Contract W-7405-ENG-26)
(ORNL-4126)

Based on a detailed study of a selected literature, a classification of the mechanisms of sorption of iodine in a reactor containment is suggested. The important parameters for each mechanism are presented, and illustrations of how these surface chemistry parameters can be incorporated with mass transfer equations are given. Specific research programs are recommended. The six mechanisms are: chemisorption on bare metal; monolayer adsorption with dissociation on dry oxides; diffusion-controlled reactions with oxide-coated metal; absorption into water or aqueous solutions; adsorption on a rapidly forming corrosion film; and sorption from a damp atmosphere. Author (NSA)

N68-10437# United Kingdom Atomic Energy Authority, Harwell (England).
RADIOACTIVE KRYPTONATES IN SCIENCE AND TECHNOLOGY
Juraj Tolgyessy and Viktor Jesenak Jan. 1967 25 p refs Transl. into ENGLISH from Jaderna Energie (Czechoslovakia), v. 12, no. 6, Jun. 1966 p 213–230
(NP-TR-1563)

The potential significance and future of radioactive kryptonates are emphasized. The characteristics of radioactive kryptonates, methods of their production (bombardment with ^{85}K ions and diffusion of ^{85}K in solids) are given. Their properties and technical and engineering safety during work with them are described. The separate areas for the utilization of radioactive kryptonates are described in detail: detection and determination of nonradioactive substances, studies of kinetics and mechanisms of chemical reactions, measurement of the temperature of surfaces, measurement of thicknesses, elimination of static electricity, bremsstrahlung sources, and light sources. Author (NSA)

N68-10455 Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Biologie und Landwirtschaft.
THIN-LAYER CHROMATOGRAPHY OF CARBOHYDRATE [DUENNSCHICHTCHROMATOGRAPHIE DER KOHLEHYDRATE]
H. Scherz, G. Stehlik, E. Bancher, and K. Kaindl Jul. 1967 29 p refs In GERMAN Submitted for publication
(SGAE-BL-20/1967) CFSTI: $3.00

Thin layer chromatographic methods for separating carbohydrate mixtures use silica, aluminum oxide, and magnesium silicate gels to obtain the desired chromatographic separation and absorption effects. Thin layer chromatography reaches a better separation effect at shorter time than paper chromatographic methods and also possesses a higher sensitivity. This brief survey presents elutriation and separation methods for simple sugars, higher polysaccharides, and sugar derivatives. Transl. by G.G.

N68-10479# Mound Lab., Miamisburg, Ohio.
THE DECOMPOSITION OF TOLYLENE DIISOCYANATE DIMER IN THE PRESENCE OF n-HEXANOL
J. V. Dichiaro 4 Aug. 1967 8 p refs Presented at the EIVR Meeting at Lawrence Radiation Lab., Nov. 1966
(Contract AT(33-1)-GEN-53)
(MLM-1358) CFSTI: HC $3.00/MF $0.65

The reaction of 2, 4-tolylene diisocyanate dimer (TDID) with n-hexanol at 130°C was studied to establish the reaction course of TDID as a cross–linking agent for hydroxylated rubbers. A study of the reaction products by infrared spectrophotometry and thin-layer chromatography showed that TDID did not cleave during a 1 hr reaction. Thus, the TDID molecule reacts in a difunctional manner under these conditions. Author (NSA)

N68-10497*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
APPLICATION OF LIQUID-LAYER SOLID-SAMPLE SPARK TECHNIQUE TO SPECTROCHEMICAL SPARK SOURCE
Ramon M. Barnes Washington Nov. 1967 15 p refs
(NASA-TM-X-1429) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Improved analytical results were obtained when a thin layer of water or aqueous solution was aspirated onto the surface of a flat metal sample during spark analysis. Studies with liquid layers applied to aluminum alloy standards demonstrated that increased sampling and line emission produced increased analytical curve slopes and count precision for the determination of impurities. Spark exposure times were reduced by one-half to one-fifth. The solute from a solution layer was used to replace the aluminum internal standard in both the spark analysis of aluminum alloys and the dc arc analysis of the sample electrode material vapor deposited on the counter electrode. In spark analysis when a liquid layer was applied, interfering emission from atmospheric elements and from the counter electrode material was minimized, and the physical appearance of the spark crater showed no oxide formation. Inductance of the spark circuit and aspiration rate influences were investigated. Application of this method to the analysis of refractory and superalloys is indicated by the results of the analysis. Author

N68-10516# Electric Storage Battery Co., Yardley, Pa. Research Center.
HIGH ENERGY SYSTEM (ORGANIC ELECTROLYTE) Final Report, 15 Jun. 1966–14 Jun. 1967
D. P. Boden, H. R. Buhner, and V. J. Spera Ft. Monmouth, N. J. Army Electron. Command Sep. 1967 131 p refs
(Contract DA-28-043-AMC-02304(E))
(ECOM-02304-F; Rept.-8; AD-659419)

The major goal of this work was to improve the activated storage life and discharge rate capability of the Li/CuF2 cell described in AD-639 704. In addition, the scope was extended to include investigation of new cathode material and electrolytes. The most promising new solvents appeared to be propylene glycol sulfite and diethyl sulfite. A reduction of more than an order of magnitude, in the solubility of CuF2 in $LiClO_4$/P. C. solution, was effected by purification of $LiClO_4$ diethyl ether according to the method of Berglund and Sillen. A study of Li/CuF2 cells with cathodes containing purified graphite then revealed that activated storage of cells was improved, but at the expense of high cathode polarization. A program of separator and ion exchange membrane evaluation revealed that conventional microporous separators were

incapable of preventing the transfer of soluble copper species and subsequent galvanic deposition of copper on the Li anode and resultant cell failure on activated storage. The results of kinetic studies of the CuF2 cathode discharge mechanism appear to indicate that the reaction is diffusion controlled. TAB

N68-10518# Standard Oil Co., Cleveland, Ohio.
LOW FREQUENCY INFRARED SPECTRA OF ACETONITRILE AND ACRYLONITRILE DERIVATIVES OF CHROMIUM, MOLYBDENUM AND TUNGSTEN HEXACARBONYLS
Michael F. Farona (Akron Univ.), Jeanette G. Grasselli, and Bonnie L. Ross Wright-Patterson AFB, Ohio AF Materials Lab. Aug. 1967 17 p refs
(Contract AF 33(615)-2746)
(PR-3187; AFML-TR-67-73; AD-659447)

The infrared spectra of the complexes M(CO)6-n (L)n (M = Cr, W; L = CH3CN, n = 1, 2; L = CH2CHCN, n =1) and M(CO)3(CH3CN)3 (M = Cr, Mo, W) in the CsBr region were studied. The spectra of W(CO)6-n(CH3CN)n (n = 1, 2, 3) were investigated in the 400-100/cm region, and whereas three very weak bands are observed in the spectrum of W(CO)3(CH3CN)3 below 265/cm, the mono- and disubstituted derivatives exhibit no adsorption bands in the 400-100/cm region. For the mono- and disubstituted derivatives, all bands in the 700-265/cm region arise from metal-carbon stretching, MCO bending and CCN bending; and no metal-nitrogen stretching bands could be assigned. However, for M(CO)3(CH3CN)3 metal-nitrogen stretching vibrations are assigned at 552, 495/cm (Cr); 533, 481/cm (Mo); and 538, 489/cm (W). The bands below 265/cm in the spectrum of W(CO)3(CH3CN)3 were tentatively assigned to WNC bending modes. Author (TAB)

N68-10524# New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.
IDENTIFICATION OF COMPLEX PHOSPHATES IN NEUTRON IRRADIATED PHOSPHORUS OXY-ANION SALTS
Vincent C. Anselmo and Ernest Sanchez 1 Aug. 1967 6 p refs
(Contract AT(11-1)-1618)
(COO-1618-2) CFSTI: HC $3.00/MF $0.65

An attempt was made to identify the complex phosphates previously identified as being formed in thermal neutron–irradiated orthophosphates, orthophosphites, and hypophosphites. Gradient elution anion exchange chromatography, under different conditions, was the analytical method used. It was concluded that the species are of high molecular weight and contain more than 14 or 15 phosphorus atoms. Author (NSA)

N68-10533# New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.
NITROGEN CONTAINING PHOSPHORUS OXY-ANIONS IN NEUTRON IRRADIATED HYPOPHOSPHITES WHEN DISSOLVED IN LIQUID AMMONIA
Vincent C. Anselmo and Ernest Sanchez (Eberline Instrument Corp.) 1 Aug. 1967 8 p refs
(Contract AT(11-1)-1618)
(COO-1618-4) CFSTI: HC $3.00/MF $0.65

Ammonium and calcium hypophosphites were irradiated with thermal neutrons, quenched and stored in liquid nitrogen, dissolved in liquid ammonia, and separated by anion exchange. Quantitative isothermal annealing data are presented on ammonium hypophosphite. Calcium hypophosphite was virtually insoluble in liquid ammonia, so quantitative data are lacking. Data indicated that present in the solution are nitrogen-containing phosphorus oxy-anions of unknown compositions that are formed by a reactor between a fragment in the solid and the liquid ammonia. NSA

N68-10538# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.
CONCENTRATION FLUCTUATIONS IN THE VICINITY OF THE CRITICAL POINT Final Report
Benjamin Widom 30 Sep. 1967 5 p refs
(Grant AF-AFOSR-1253-67)
(AFOSR-67-2300; AD-659466) CFSTI: HC $3.00/MF $0.65

A brief summary is given of work involving (1) the measurement of the relaxation times of concentration fluctions by the electric field effect on critical opalescence (reported in detail in AD-642 606 and AD-649 353); (2) visual observations of concentration fluctuations in a critical mixture; and (3) elastic scattering of light near the critical temperature. TAB

N68-10540# Brown Univ., Providence, R. I.
DETAILED STUDIES OF CHEMICAL REACTION KINETICS Final Report
E. F. Greene and J. Ross 8 Oct. 1967 6 p refs
(Contract DA-31-124-ARO(D)-163)
(AROD-4676.7-C; AD-659393) CFSTI: HC $3.00/MF $0.65

A brief summary is given of theoretical and experimental studies of the details of the kinetics of chemical reactions. The primary experimental approaches were (1) measurement of the scattering of alkali metal atomic beams by crossed beams of various target molecules and (2) shock wave studies of X2 and HX molecules. Theoretical effort was directed toward an understanding of the nature of inelastic and chemically reactive collisions. TAB

N68-10554# Oak Ridge National Lab., Tenn.
KINETICS OF TRANSURANIUM ELEMENT OXIDATION—REDUCTION REACTIONS IN SOLUTION [CINETIQUE DES REACTIONS D'OXYDO-REDUCTION DES ELEMENTS TRANSURANIENS EN SOLUTION]
Daniel Gourisse Sep. 1966 56 p refs Transl. into ENGLISH from the French Rept. CEA-R-3079
(ORNL-TR-1644; CEA-R-3079) CFSTI: HC $3.00/MF $0.65

A systematic review of the kinetics of oxidation–reduction reactions of the elements U, Np, and Am in perchlorate solution is proposed. Some considerations relative to the thermodynamic values of activation associated with elementary behavior (effect of compensation, standard entropy of active complexes, reaction velocity) are developed. The influence of acidity, ionic strength, heavy water, and the polarity of mixed solvents on the speed of reactions is described. Finally, the influence of different anions on the velocity of reactions is explained by the variations in the free standard enthalpy of the reaction and by the variations in the free enthalpy of activation (work of electrostatic forces) resulting from the complexing of species dissolved in the solution. Author (NSA)

N68-10555# Arizona Univ., Tucson.
LADDER POLYMERS Final Report
J. E. Mulvaney Jun. 1967 4 p
(Contract DA-31-124-ARO(D)-232)
(AROD-4474-1-C; AD-659408)

A brief summary is given of work directed toward the preparation of Si-hetero, B-hetero, and spiro type ladder polymers. TAB

N68-10572# Minnesota Univ., Minneapolis.
CHARGE TRANSPORT IN METAL-MOLTEN SALT SOLUTIONS Final Report, 30 Jun. 1964–29 Jun. 1967
H. T. Davis 29 Jun. 1967 4 p
(Contract DA-31-124-ARO-D-241)
(Rept.-4763.5-C; AD-659410) CFSTI: HC $3.00/MF $0.65

A brief summary is given of work involving (1) the statistical mechanics of equilibrium and transport processes in molten salts and metal-molten salt solutions and (2) the experimental investigation of the same processes. A list of publications resulting from the work is included. TAB

N68-10609# Tyco Labs., Inc., Waltham, Mass.
INVESTIGATION OF THE GROWTH OF SINGLE CRYSTAL SILICON CARBIDE BY THE TRAVELLING SOLVENT AND OTHER METHODS
B. N. Das, C. B. Lamport, A. I. Mlavsky, E. A. Trickett, and G. A. Wolff Jul. 1967 19 p refs
(Contract F19628-67-C-0186)
(AFCRL-67-0509; SR-1; AD-659464)

The Travelling Heater Method (THM) crystal growth of SiC from a graphite crucible in Cr-Si-C was investigated. Porous, coarse crystalline, cylindrical SiC rods were obtained. Preliminary results strongly suggest that the growth of solid SiC rods by THM will be experimentally feasible, if axial and radial heat flow and temperature gradient are properly monitored. Beta-SiC whiskers were grown by a VLS mechanism. An attempt is being made to analyze the composition of the growth matrix material by X-ray and electron diffraction so that SiC whiskers, or large SiC crystals, could reproducibly be grown from this solvent. The recently developed laser reflectogram technique was applied to the study of the SiC surface crystallography for various SiC crystal preparations and surface treatments. Author (TAB)

N68-10621# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PROMETHIUM HEAT SOURCE COMPATIBILITY STUDIES. PART 2: METAL–METAL COMPATIBILITY AT 1100°C
L. J. Kirby and H. T. Fullam May 1967 16 p refs
(Contract AT(45-1)-1830)
(BNWL-398) CFSTI: HC$3.00/MF$0.65

Metal–metal couples were studied after exposures up to 4000 hr at 1100°C to characterize and evaluate reactions that occurred. The couples studied included: Hastelloy X with Re, Mo–50 Re, W–25 Re, W, and Ta; Ta with Re, W–25 Re, and W; 304L SS with Re, W–25 Re, Mo–50 Re, Ta, Ir, and Pt; Re with Mo–50 Re, W–25 Re, and Pt; and Pt with W–25 Re. In addition, the reactions of Hastelloy X and Hastelloy C with Re, W–25 Re, and Ta were studied following experiments where the temperature was cycled (700 to 1100°C). Hastelloy X and 304L SS reacted with Re, Mo–50 Re, and W–25 Re to form diffusion zones where there was little tendency for the individual metals in Hastelloy X or 304L SS to migrate preferentially. The diffusion zone appeared to approach a limiting thickness in long term tests of the 304L–Re couple. In reactions between Hastelloy X or 304L SS and Ta, Ni tended to concentrate at the Ta-rich side of the diffusion zone. Fe showed a finite but lesser tendency to concentrate at the Ta-rich side, while Cr showed no tendency toward this preferential migration. Ta reacted very slightly with Re, W–25 Re, and W. Pt reacted extensively with Re and W–25 Re, and was totally unacceptable as a liner for 304L SS capsules. Ir behaved similarly with 304L SS. Hastelloy C, studied only in temperature cycling tests with Re, W–25 Re, and Ta, was slightly less reactive than Hastelloy X. When compared with the static tests, the diffusion reactions were generally more pronounced for temperature cycling tests with Hastelloy X. Author (NSA)

N68-10637# Wisconsin Univ., Madison.
A KINETIC AND REACTION MECHANISM STUDY OF THE FORMATION AND DECOMPOSITION OF THE URANYL ION IN ORGANIC MEDIA Quarterly Progress Report
J. L. Shohet 15 Jun. 1967 6 p
(Contract AT(11-1)-1695)
(COO-1695-3; QPR-1) CFSTI: HC$3.00/MF$0.65

The quantum yield for photochemical reduction of uranyl nitrate hexahydrate in propionaldehyde with a 435 mμ mercury band was determined at 25°C. The quantum yield for the reduction of the uranyl nitrate was found to be 0.01. A design for a precision solution calorimeter is described. Improvements incorporated into the instrument are a thin-walled Dewar flask; a thermistor sensor in combination with a Mueller Bridge and voltage amplifier; and certain design features that more effectively isolate the reaction chamber from the constant-temperature surroundings. A two-compartment electrolytic cell was designed and operated using ethyl alcohol–uranyl acetate electrolyte and platinum wire helixes as electrodes. When one half of the unit was illuminated with a sun lamp, a potential of about 0.3 volt developed after a short induction period. An investigation of the complexation of 2-amino-2-deoxygluconic acid with uranium (VI) was made. From spectrophotometric measurements it appears that uranium (VI) formed a complex with 2-amino-2-deoxygluconic acid with maximum stability at pH = 12. NSA

N68-10644# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
THE CHARACTERISTICS OF SEVERAL NEW METAL PHOSPHINATE COMPLEXES
James J. Pitts, Martin A. Robinson, and Samuel I. Trotz 26 Sep 1967 23 p refs Submitted for publication
(Contract Nonr-5039(00))
(TR-2; AD-659067)

Four series of metal phosphinate complexes based on the phosphinic acids, $(C_6H_5)_2P(O)OH$, $C_6H_5(H)P(O)OH$, $(C_6H_5)_2P(S)OH$, and $(C_6H_5)_2P(S)SH$ were synthesized and characterized. Although the primary interest was in the complexes of aluminum(III), nickel(II) and cadmium(II), several other metal complexes were synthesized for comparison purposes. Structural features are discussed, relating the formation of chelated monomer or ligand bridged polymer to the size of the metal cation and to the sulfur or oxygen moieties of the ligands. Hydrolytic stabilities were successfully correlated to the hard-soft concept of acid-base theory. The predicted general relationship seems to exist between the thermal stability and the ionic character of the metal to ligand bonding. Author (TAB)

N68-10664# Aktiebolaget Atomenergi, Studsvik (Sweden).
CONVERSION OF URANIUM HEXAFLUORIDE TO URANIUM DIOXIDE
Anders Nystroem Jul. 1967 30 p refs
(FTB-4)

A literature survey of 78 references on the subject was compiled from Nuclear Science Abstracts covering the period from 1963 through June 1967. The references were retrieved under the subject heading Uranium (VI) Fluorides. Such aspects as analytical methods, instrumentation, handling procedures, purification, fluorine recovery, properties, and safety are considered. The survey is supplied with abstracts and and author indexes. Author (NSA)

N68-10687 European Atomic Energy Community, Karlsruhe (West Germany). Joint Nuclear Research Center.
A METALLOGRAPHIC AND X-RAY INVESTIGATION OF PLUTONIUM OXIDES AT ROOM TEMPERATURE
C. Sari, U. Benedict, and H. Blank Brussels EURATOM Aug. 1967 56 p refs
(EUR-3564.e) CFSTI: $3.00

Plutonium oxides in the range $1.61 \leq O/Pu \leq 2.00$ have been investigated at room temperature both by metallography and by X-ray analysis, mainly on samples quenched from about 1500°C to 5°C. Specimens with compositions $1.627 < O/Pu \leq 1.69$ are single phase α-type at 650°C and this phase can be quenched to room temperature to a high degree. Sepcimens with $1.69 < O/Pu \leq 1.995$ invariably transform to a two-phase structure $\alpha + \gamma(\gamma = PuO_{2-x})$ on quenching through the 650° phase boundary known from previous published phase diagrams. These phase diagrams have to be modified on the basis of the present results in two respects: (1) α-Pu_2O_3 which has been taken earlier as a compound with $O/Pu = 1.61$ exists as an extended phase in the range $1.62 < O/Pu \leq 1.69$ at $T > 650°C$. This range becomes narrower with

decreasing temperature and terminates in a point near $O/Pu \approx 1.62 \div 1.63$ at about 350°C. (2) The oxygen deficient fluorite phase PuO_{2-x} at 350°C in equilibrium with the α-phase has a composition close to PuO_2, that is about $PuO_{1.995}$ instead of $PuO_{1.98}$ as claimed before. (3) Reinterpretation of published data on the Pu-O system suggest, that above 650°C the α-phase is separated from the highly oxygen deficient γ-phase (PuO_{2-x}) by a narrow two-phase region $\alpha+\gamma$ in the range $1.69 \leq O/Pu \leq 1.72$. The variation of the low oxygen side of the boundary of the α-phase field with temperature near $O/Pu = 1.62$ is not yet known with certainty. Also the details of the transformation process and their variation with oxygen content for samples in the region $1.70 < O/Pu < 1.995$ cannot be explained at present. Author

N68-10740# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.

A STUDY OF SOME FACTORS WHICH INFLUENCE THE GROWTH OF CUPROUS CHLORIDE IN SILICA GEL

Alton F. Armington, Mary A. Dipietro, and John J. O'Connor Jul. 1967 17 p refs *Its* Phys. Sci. Res. Papers No. 334
(AFCRL-67-0445; AD-659135)

A technique is presented for growing larger crystals in gels than can be produced by the usual gel-growth method. While the system described is based on the dilution technique previously reported by the authors, it should be applicable to all gel-growth systems. The parameters necessary for the growth of clear cuprous chloride are also evaluated. Author (TAB)

N68-10753# National Lead Co. of Ohio, Cincinnati. Technical Div.

OBSERVATION OF THE ELECTROLYSIS OF UO_2 AT MALLINCKRODT CHEMICAL WORKS, WELDON SPRING, MISSOURI FROM JUNE 1, 1966–OCTOBER 7, 1966

R. J. Lusky and G. Brodi May 1967 23 p refs
(Contract AT(30-1)-1156)
(NLCO-994) CFSTI: HC $3.00/MF $0.65

From observations at Mallinckrodt Chemical Works it was concluded that the electrolysis of UO_2 to U is technically feasible in laboratory and pilot plant studies, but the economic feasibility of the process was not demonstrated. The large-scale operation was plagued by insufficient cathode current density, excessive anode current density, unsatisfactory methods of heating and heat transfer, and inadequate materials of construction. NSA

N68-10754# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung.

THE DEPOSITION OF MOLYBDENUM OF ZrO_2 AND UO_2 SPHERES FROM THE GAS PHASE [DIE ABSCHEIDUNG VON MOLYBDAEN AUF ZrO_2- UND UO_2-KUGELN AUS DER GASPHASE]

H. Schneider and D. Schoenwald Jan. 1967 22 p refs In GERMAN
(KFK-555)

The deposition of metallic Mo from the gas phase by reduction of molybdenum pentachloride was proposed for the coating of UO_2 spheres. In the course of research with zirconium oxide it was established that $MoCl_5$ not supplied in ampules is very strongly contaminated with oxygen, and must be freshly sublimed before each research series. The method was then tested on zirconium oxide spheres in small charges, in which up to 25 wt % Mo was prepared and then transferred to UO_2 spheres. Up to 21 wt % Mo with filler masses of 100-g UO_2 was evaporated. The techniques were so improved that 100-g UO_2 charges could be coated with pure Mo layers with safety and good yields. The surface properties of the deposited Mo were evaluated visually with a microscope and its purity was detected with chemical and X-ray methods. The parameters of layer quality and yield are discussed with special consideration of the evaporation and gas velocities. Author (NSA)

N68-10755# Atomic Energy Commission, New Brunswick, N. J. New Brunswick Lab.

PLUTONIUM NITRATE SOLUTIONS. SUMMARY OF THE RESULTS OF THE GENERAL ANALYTICAL EVALUATION PROGRAM, JULY 1965–JUNE 1966

E. S. Roszkowski Apr. 1967 35 p
(NBL-239) CFSTI: HC $3.00/MF $0.65

The plutonium content and isotopic assays of ^{239}Pu and ^{241}Pu were the analyses considered in a program for plutonium nitrate solutions in the General Analytical Evaluation (GAE) Program. Eleven laboratories contributed analytical data for the GAE program. The samples distributed were either plant process solutions or reference standard solutions randomly selected, one sample per month, starting July 1965, and continuing for twelve months. A variety of procedures was used. The process solutions and synthetic solutions data were treated in separate groups. A measure of the laboratory's reproducibility, as well as its reproducibility relative to the sample averages, are indicated in the data. NSA

N68-10765# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.

DETERMINATION OF THE SPECIFIC α-ACTIVITY OF U-233 USING A LIQUID SCINTILLATION COUNTING METHOD [BESTIMMUNG DER SPEZIFISCHEN α-AKTIVITAET DES U-233 MIT HILFE EINER FLUESSIG-SZINTILLATIONSZAEHL-METHODE]

H. R. Ihle, E. Langenscheidt, and A. P. Murrenhoff Jun. 1967 61 p refs In GERMAN; ENGLISH summary
(JUL-491-PC) CFSTI: HC $3.00/MF $0.65

By use of an improved liquid scintillation counting method the specific α-activity of U-233 has been determined to $21{,}014 \pm 42$ disintegrations $\cdot min^{-1} \cdot \mu g^{-1}$, which corresponds to a half life of $162{,}100 \pm 320$ years. The final purification of the U-233 source used in this work was carried out by a solvent extraction method, which allows the separation of a great number of impurity elements from uranium by a simple procedure. Author

N68-10769 Lockheed Missiles and Space Co., Palo Alto, Calif.

SYNTHESIS OF LEAD TELLURIDE BY DEPOSITION FROM SOLUTIONS

M. A. Berchenko and A. I. Beliaev [1967] 7 p refs Transl. into ENGLISH from the book "Chalogenides" Kiev, Nauk. Dumka Press, 1967 p 94–100

Various methods of synthesizing lead telluride by deposition from solutions are discussed, including hydrothermal synthesis, the passing of gaseous hydrogen telluride through lead salt, and reduction of mixed solutions of lead and tellurium. Production of lead telluride is discussed in terms of hydrazine reduction method and by reducing zinc telluride in an alkaline medium followed by treatment with an appropriate metallic salt. Black powders of similar granulometry, purity, and semiconducting properties result from both methods. These chemical methods of producing lead telluride are considered applicable to large-scale manufacturing at reduced costs, even though the PbTe with semiconductor purity can be produced from relatively contaminated materials. M.W.R.

N68-10770# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.

LIQUID CRYSTALS AS A NONDESTRUCTIVE INSPECTION TOOL, FEASIBILITY STUDY

John F. Erthal 28 Jun. 1967 49 p refs
(NAEC-AML-2634; AD-659189)

This feasibility study consisted of a literature survey and visits to activities using liquid crystals. It was found that the use of liquid crystals as a nondestructive inspection tool is not only feasible, but a reality for the inspection of certain aircraft structures and assemblies. However, specific applications require study and experimentation prior to use. Author (TAB)

N68-10772# Naval Radiological Defense Lab., San Francisco, Calif.

SOLUTE DISTRIBUTION IN THE Na_2O–B_2O_2–NaCl SYSTEM. IV: POLYBORATE STRUCTURES AND EQUILIBRIA

Monte H. Rowell 3 Jul. 1967 36 p refs

(USNRDL-TR-67-86; AD-659283)

Analysis of the conjugate liquid phases in the immiscibility region of the Na2O-B2O3-NaCl system at 830C reveals discontinuities in the trends of solubility of each phase in the other. The discontinuities occur when the proportions of Na2O and B2O3 in the borate phase reach Na2O.5B2O3, Na2O.4B2O3, and Na2O.3B2O3. The solubility behavior is explained in terms of formation of polyborate groups with these compositions; changes in structural ordering at these points, and different equilibria between species in different composition regions. Author (TAB)

N68-10783 European Atomic Energy Community, Karlsruhe (West Germany). Joint Nuclear Research Center.

A COMPARISON OF THE Pu–O SYSTEM WITH THE RARE EARTH OXIDE SYSTEMS Ce–O, Pr–O AND Tb–O

H. Blank Brussels EURATOM Aug. 1967 42 p refs

(EUR-3563.e) CFSTI: $3.00

The phase diagrams and the lattice parameters of the cubic and pseudo cubic phases of the Pu–O system on the one side are compared with those of the Ce–O, Pr–O and Tb–O systems on the other side. The features common to all four phase diagrams are an extended region MO_{2-x} above 650°C, a miscibility gap between MO_2 and $MO_{1.83}$ or $MO_{1.70}$ at low temperatures and a modified C type phase at higher temperatures for $O/M \leq 1.69$. This leaves $1.83 = O/M = 1.71$ as the region where differences exist between the two groups of diagrams. In this range the rare earth oxides exibit disturbed pseudo cubic intermediate phases whereas the Pu–O system does not show them. This difference in behaviour can be correlated with the change of the lattice parameters of the cubic and pseudo cubic phases with the O/M-ratio and with their dependence on temperature. It gives indications on the type of interaction between the lattice defects in these oxide systems. For the Pu–O system it is shown that a new modified phase diagram is in good agreement with published X-ray and EMF data. Author

N68-10785# Los Alamos Scientific Lab., N. Mex.

ACTIVITY OF UCl_3 IN THE EUTECTIC LiCl-KCl MELT

O. Knacke, J. Krahe, and F. Mueller [1966] 21 p refs Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 50, 1966 p 91–104

(LA-TR-67-76) CFSTI: HC $3.00/MF $0.65

The activity of UCl_3 was determined by emf measurements in the cell Ag/U/LiCl–KCl–UCl_3/LiCl–KCl–AgCl/Ag. At uranium contents up to 0.5 mol % UCl_3 at 450 to 650 C the activity of the UCl_3 was approximately equal to its mole fraction with pure liquid UCl_3 as the reference state. The UCl_3 was generated in the melt itself by anodic dissolution of a uranium rod. The activity coefficient, $f^{o}_{sol.}$ can be calculated as: $RT \ln f^{o}_{sol} = 10.850 - 10.21T$ and $\lg f^{o}_{sol} = 2372/T - 2.23$. NSA

N68-10790# Los Alamos Scientific Lab., N. Mex.

PREPARATION AND STUDY OF THE NITRIDES AND CARBONITRIDES OF URANIUM AND OF PLUTONIUM [PREPARATION ET ETUDE DES NITRURES ET CARBONITRURES D'URANIUM ET DE PLUTONIUM]

Francois Anselin Jun. 1966 89 p refs Transl. into ENGLISH from French

(LA-TR-67-24; CEA-R-2988)

A detailed description is given of a simple method for preparing uranium and plutonium nitrides by the direct action of nitrogen under pressure at moderate temperatures (about 400°C) on the partially hydrogenated bulk metal. It is shown that there is complete miscibility between the UN and PuN phases. The variations in the reticular parameters of the samples as a function of temperature and in the presence of oxide were used to detect and evaluate the solubility of oxygen in the different phases. A study was made of the sintering of these nitrides as a function of the preparation conditions with or without sintering additives. A favorable, but nonreproducible, effect was found for traces of oxide. The best results were obtained for pure UN at 1600°C (96% theoretical density) on condition that a well-defined powder was used. The criterion used is the integral width of the X-ray diffraction lines. The compounds UN and PuN are completely miscible with the corresponding carbides. This makes it possible to prepare carbide–nitrides of the general formula (U,Pu) (C,N) by solid-phase diffusion at around 1400°C. The sintering of these carbide–nitrides is similar to that of the carbides if the nitrogen content is low; in particular, nickel is an efficient sintering agent. For high contents, the sintering is similar to that of pure nitrides. Author (NSA)

N68-10813# Oak Ridge National Lab., Tenn.

SPECTROGRAPHIC DETERMINATION OF SMALL QUANTITIES OF BORON IN IRON AND STEELS BY MEANS OF A PREDISPERSIVE SPECTROMETER [DOSAGE SPECTROGRAPHIQUE DE PETITES QUANTITES DE BORE DANS LE FER ET LES ACIERS A L'AIDE DU SEPARATEUR D'ORDRES]

Danh Tran Van and Jacques Ernoult Jan. 1966 15 p refs Transl. into ENGLISH from French

(ORNL-TR-1339; CEA-R-2914)

Small quantities of boron in iron and steels were determined by means of a spectrographic method using a predispersive spectrometer. Samples containing more than 5 ppM of boron can be analyzed with standard deviation of about 10%. Author (NSA)

N68-10823 Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

STUDY OF THE CHEMICAL POTENTIALS AND ACTIVITY COEFFICIENTS OF THE COMPONENTS OF BINARY SOLID SOLUTIONS BY THE METHOD OF THE THIRD COMPONENT

M. M. Shul'ts, A. V. Storonkin, and T. P. Markova Oct. 1967 14 p refs Transl. into ENGLISH from Zh. Fiz. Khim (Moscow), v. 32, no. 11, 1958 p 2508–2524

(PA-TT-59; AD-659339)

One of the possible methods for determining the changes in the chemical potentials and activity coefficients called the third component method was examined. The method consists in calculation of the above quantities from the data on the solubility of the binary solid solutions in a liquid solvent and on the changes in the chemical potential of the latter. With the aid of the proposed method changes in the chemical potentials and activity coefficients of the binary solid solution K2SO4 - (NH4)2SO4 were calculated. The data required for the calculation were obtained from a study of the compositions of the co-existing phases and of the water vapor pressure over the saturated solution in the system K2SO4 - (NH4)2SO4 - H2O at 25C. Author (TAB)

N68-10832# California Univ., Santa Barbara. Dept. of Chemistry.

SPECTROSCOPY OF EDA COMPLEXES AT HIGH PRESSURES. VI: ABSORPTION AND FLUORESCENCE OF CRYSTALLINE TNB AND TNF COMPLEXES

A. H. Kadhim and H. W. Offen 26 Sep. 1967 20 p refs Submitted for publication

(Contract N00014-67-A-0120-0001)

(TR-7; AD-659533)

Several aromatic hydrocarbons are complexed with trinitrobenzene (TNB) and trinitrofluorenone (TNF) in the crystalline state and subjected to increasing pressures (0-30 kbar). The charge transfer absorption shows a approx. 1200/cm red shift, while the

fluorescence red shift may vary between 200-1700/cm at 25 kbar. In the same complexes the Stokes shift decreases at higher pressures. This decrease can be understood in terms of charge transfer forces and potential energy curves appropriate for weak EDA-complexes. Author (TAB)

N68-10857# Naval Radiological Defense Lab., San Francisco, Calif.
ION EXCHANGE IN FUSED SALTS. IV: DISTRIBUTION OF SELECTED TRANSITION ELEMENTS IN THE CHABAZITE-MOLTEN $NaNO_3$ SYSTEM
Clarence M. Callahan 6 Oct. 1967 22 p refs
(Contract AT(49-7)-1167)
(USNRDL-TR-67-104; AD-659281)

A study was made of the ion-exchange distributions of Co60, La140, Ce141, and Eu152-154 between Nova Scotia chabazite (a zeolite) and molten NaNO3 at 330C. The nitrates of cobalt and cerium were found to decompose at this temperature and their respective oxides were precipitated. Lanthanum and europium apparently replaced aluminum in the alumino-silicate framework of the chabazite. The presence of an inflection in the adsorption curve for europium was attributed to a lattice rearrangement in the chabazite. The analyses of several lots of natural chabazite showed that the exchangeable ions are primarily Ca, Na, and K. By repeated equilibrations in molten NaNO3 the natural chabazite was converted to sodium chabazite. Enhanced distribution coefficients and reduced hysteresis effects were obtained when Na22, Cs137, and Ba133 were equilibrated in a sodium chabazite-molten NaNO3 system as compared to the natural chabazite-molten NaNO3 system. A similar increase in the distribution coefficient was observed for Na22 in the lithium chabazite-molten LiNO3 system. Distribution coefficients were obtained also for Ag110m in the sodium chabazite-molten NaNO3 and lithium chabazite-molten LiNO3 systems. The position of Ag110m in the selectivity sequences for these systems was that predicted on the basis of ion size and ion charge. Author (TAB)

N68-10863 Commissariat a l'Energie Atomique, Saclay (France).
PLANT FOR SINGLE-TIER EXTRACTION BY SOLVENT [INSTALLATION D'EXTRACTION PAR SOLVANT A UN SEUL ETAGE (PROJECT GLAUCIDIE)]
J. Fradin and C. Gaudichard Brussels EURATOM Sep. 1967 87 p In FRENCH; ENGLISH summary
(Contract EURATOM-025-62-10 RISF)
(EUR-3612.f)

A plant has been constructed for the study by successive stages of the extraction by solvent of strontium-90 and rare earths from caesium-137-free fission-product solutions. The main characteristics of this plant being simplicity and versatility, it makes it possible to study new extractants and to carry out every operation of liquid-liquid extraction relating to highly radioactive solutions. The report describes the plant, its chemical apparatus and the control, measurement, regulation and monitoring equipment. Author

N68-10864 Commissariat a l'Energie Atomique, Saclay (France).
DESIGN OF A PILOT CELL FOR STRONTIUM-90 EXTRACTION BY SOLVENT [PROJET DE CELLULE PILOTE D'EXTRACTION PAR SOLVANT DU STRONTIUM 90]
J. Fradin Brussels EURATOM Sep. 1967 108 p In FRENCH; ENGLISH summary
(Contract EURATOM-025-62-10- RISF)
(EUR-3613.f)

The design of this plant was undertaken with the object of constructing a pilot apparatus for the study of the separation of the elements contained in fission products. The plant should yield technological information as well as data on the process (efficiency, Kd value, etc.). It is also felt that this plant might serve as a basis for the design of a unit for the production of strontium-90 and rare earths for treating effluent solutions from an irradiated fuel reprocessing plant. The report includes a description of the process and an examination of the safety precautions, the equipment, and the controls, measurements and monitoring and regulating devices. Author

N68-10879# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
A METHOD OF MEASURING EXCHANGE CAPACITANCE AND KINETIC CHARACTERISTICS OF IONITES [METODIKA IZMERENIYA OBMENNOI EMKOSTI I KINETICHESKIKH KHARAKTERISTIK IONITOV]
B. A. Alekseev, D. S. Ilina, and V. S. Tshernorotov [1966] 61 p refs Transl. into FRENCH from Russian Rept. ZFK-RN-17, 1966 p 75–94
(ZFK-RN-17; CEA-TR-R-1888)

The exchange capacitance of ion-exchange resins used for water purification in research and power reactors is measured by potentiometric titration of cation or anion exchange resins by alkali or acid solutions, and analyzing the time dependence of the titration. NSA

N68-10902# Mound Lab., Miamisburg, Ohio.
STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION, JANUARY–MARCH 1967
G. R. Grove and R. E. Vallee 31 Mar. 1967 35 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1409) CFSTI: HC $3.00/MF $0.65

Developments in the separation and purification of stable rare gas isotopes by thermal diffusion and chromatography are described. The production of ^{21}Ne and ^{136}Xe by thermal diffusion and ^{136}Xe by chromatography is discussed. Transport coefficient determinations were continued for He, Kr, Ne, and Xe. Computer calculation showed that high ^{21}Ne enrichments could be obtained by using deuterated methane as an auxiliary gas and preliminary results support these calculations. Calculations predicting the characteristics of a U-tube superleak apparatus for ^{3}He separation from ^{4}He indicate that the upper limit of ^{3}He enrichment is reached because the required temperature gradient across the two arms would necessitate that the pure ^{4}He arm be above the lambda point and therefore no fountain pressure could be present. Recent thermal transpiration theory is discussed and a theoretical generalization is calculated. Measurements of the relative thermomolecular pressure difference for gaseous Ar, N and Co were made. The Ar and N data are incomplete but CO data showed changeable results indicating the need for a temperature dependent accommodation coefficient. NSA

N68-10935 Cekmece Nuclear Research Center, Istanbul (Turkey).
SYNTHESES BASED ON CHOLANIC ACID, Δ^{23}-CHOLENE AND 23-AMINO NORCHOLANE
Envare Uenseren Apr. 1967 11 p refs
(CNAEM-45) CFSTI: $3.00

Reduction of cholanic acid (III) with lithium aluminum hydride gave cholanyl alcohol (IV). Benzoate, chloride, pyridinium chloride hydrate, ethyl carbonate, and S-methyl xanthate derivatives of cholanyl alcohol have been prepared. The Δ^{23}-cholene has been obtained by the pyrolysis of the last two products. Osmium tetroxide hydroxylation of Δ^{23}-cholene afforded 23,24-dioxy cholane (VIII). Schmidt reaction on cholanic acid gave 23-amino norcholane (IX). Acetyl, benzoyl, and tosyl derivatives of the amine have been prepared. Reaction with potassium isocyanate gave norcholanyl urea (IX e). Norcholanic acid (X) has been obtained by the alcaline permanganate oxidation of 23-amino norcholane. Lithium aluminum hydride reduction of norcholanic acid gave norcholanyl alcohol (XI). Author

N68-10948# Oak Ridge National Lab., Tenn.
CURRENT CAPABILITIES IN ANALYSIS OF TRACE SUBSTANCES: ELECTROANALYTICAL METHODS

Myron T. Kelley [1967] 6 p Presented at 1st Ann. Conf. on Trace Substances in Environ. Health, Columbia, Mo.
(Contract W-7405-ENG-26)
(ORNL-P-3261)

Methods and applications of electrolytic conductivity, glass electrodes, voltammetry, chronopotentiometry, and coulometry for trace analysis are discussed. NSA

N68-10965 Japan Atomic Energy Research Inst., Tokyo. Div. of Research.
USE OF EXTRACTION-PHOTOMETRIC TECHNIQUE IN ACTIVATION ANALYSIS—DETERMINATION OF GALLIUM AND INDIUM IN ALUMINUM AND ZINC
Kenji Motojima, Hiroshi Hashitani, Shoji Bando, and Hideyo Yoshida Sep. 1967 16 p refs
(JAERI-1148)

The use of the extraction-photometric technique both for the separation of the desired nuclide and for the determination of chemical yield in activation analysis has been investigated. As a first attempt, the methods for determining traces of gallium and indium in aluminum and zinc by use of 2-methyl-oxine have been established. An aluminum or zinc sample which had been irradiated in a reactor, JRR-1, with a neutron flux of $10^{11}/cm^2$. sec for 2 hours and cooled for a suitable time (10 hours for gallium and 15 minutes for indium), was dissolved in hydrochloric acid. Gallium-72 or ^{116m}In was extracted into chloroform with 5 mg of each carrier, as the 2-methyl-oxine complex under a suitable condition, respectively. The radioactivity and the absorbance were measured with different portions of the chloroform solution. The radioactivity was corrected for the chemical yield which was obtained from the photometric measurement. Gallium or indium was determined from the radioactivity by comparison with that of each standard. The proposed methods were simple and rapid, and was useful to determine concentrations down to 0.5ppm of gallium and as low as 0.1ppm-level of indium. The interferences of other impurities were investigated both radiometrically and photometrically. Author

N68-10983 Lockheed Missiles and Space Co., Palo Alto, Calif.
ABSORPTION SPECTRA OF SOME ATMOSPHERIC GASES IN THE VACUUM ULTRAVIOLET
V. P. Belozerova [1967] 14 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), no. 3, 1967 p 50–57

A survey is presented on absorption spectra of atmospheric and inert gases. It is found that oxygen and nitrogen spectra were studied most, but there is no complete consistency in results. The hydrogen molecule was studied theoretically more completely, but there are discrepancies in estimating the maximum absorption in the continuum. Data on caron monoxide, carbon dioxide, nitrous oxide, nitric oxide, and water vapor are found to be approximate and frequently not in agreement. A small amount of work was done on inert gas spectra. N.E.N.

N68-11002# Picatinny Arsenal, Dover, N. J. Feltman Research Lab.
INVESTIGATION OF THE CHEMICAL POTENTIALS AND ACTIVITY COEFFICIENTS OF THE COMPONENTS OF BINARY SOLID SOLUTIONS
A. V. Storonkin, M. M. Shul'ts, and V. V. Korchagin Oct. 1967 13 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 10, 1963 p 91–95
(PA-TT-61; AD-659338)

Binary solid solutions of K2SO4–CuSO4–6H2O, (NH4)2SO4–CuSo4–6H2O salts at 25C were investigated. The chemical potentials and activity coefficients of the components were calculated with the aid of the so-called third component method based on Gibbs–Duhem relations. The solid solutions appeared to exhibit features of regular ones. Author (TAB)

N68-11004# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
DISSOLUTION OF PLUTONIUM OXIDE
Garrel F. Molen 28 Aug. 1967 20 p
(Contract AT(29-1)-1106)
(RFP-922) CFSTI: HC$3.00/MF$0.65

The dissolution rate of plutonium oxide as a function of its specific surface area and the mean crystallite size is described. The effect of the solid-to-liquid ratio is measured in both a nitric acid–calcium fluoride solvent system and in a hydrochloric acid–stannous chloride solvent system. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-10004* Kansas Univ., Lawrence. Engineering Science Div.
SCATTERING AND DEPOLARIZATION OF ELECTROMAGNETIC WAVES BY ROUGH SURFACES
Adrian K. Fung Nov. 1965 22 p refs
(Grants NsG-298; NSF GP-2259)
(NASA-CR-89984; CRES-48-5) CSCL 20N

A general theory of omnidirectional scattering of electromagnetic waves from rough surfaces is developed under the tangent plane approximation. It is shown that the results obtained are much more general than those of what is usually called the "physical optics" method. The depolarizing effect of rough surfaces is established, and the reciprocal character of the depolarized component is shown for the back-scattered case. Author

N68-10068*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADAR ANALYSIS REPORT
30 Jan. 1967 22 p
(NASA-TM-X-63003; X-553-67-39) CFSTI: HC $3.00/MF $0.65 CSCL 17I

The pass by pass and network analyses are summarized for the radars and associated equipment for high-speed magnetic tape data recording during summer 1966. The missions covered and their launching dates are the following: Pioneer-B, August 17; Orbiter-A, August 10; GTA-11, September 12; GTA-9, June 3; and GTA-10, July 18. Tabulated data are presented, and the standardization and analysis of the tapes are briefly discussed. N.E.N.

N68-10077*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMPUTER ANALYSIS AND DESIGN OF A SUBREFLECTOR OF COMPLEX SHAPE
A. Ludwig and W. V. T. Rusch 15 Nov. 1967 18 p refs
(Contract NAS7-100)
(NASA-CR-90035; JPL-TR-32-1190) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A technique for computing the scattered pattern of a complex subreflector/illumination pattern combination is presented. Computed results are compared with both boundary value solutions and experimental data, and there is excellent agreement in both cases. Present and future applications of computed scattered patterns are also discussed. Author

N68-10090* Kansas Univ., Lawrence. Engineering Science Div.
SCATTERING THEORIES AND RADAR RETURN
Adrian K. Fung [1966] 145 p refs
(Grants NsG-298; NSF GP-2259)
(NASA-CR-89977; CRES-48-3) CSCL 20N

The Kirchhoff-Huygens method is used to investigate wave scattering from a statistically rough surface in the far zone. Terms that involve the first or second partial derivatives of the surfave are all considered and found to be of importance for angles of incidence greater than or equal to 20° in the case of backscattering. The artificial line charge introduced around the edge of the illuminated area to satisfy Maxwell's equations is found to have no effect on the mean return power. Investigation on the statistical parameters of the surface obtained through fitting experimental curves shows that these quantities are frequency sensitive and are, in general, effective parameters rather than real parameters of the surface. It is shown that the exploring wavelength has a sampling filter effect, i.e., it is sensitive only to a certain range of structure sizes, the experimentally determined range being from less than one to tens of wavelengths. Through the angular variation of the return power it is found that proper representation of the surface-height autocorrelation function will give more information about the surface.
Author

N68-10162*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SUMMARY OF AVAILABLE PROBE-TO-BUS COMMUNICATION-RATES FOR A MARS 1971 MISSION
John R. Cressy and John E. Ainsworth Oct. 1967 8 p
(NASA-TM-X-55993; X-621-67-504) CFSTI: HC $3.00/MF $0.65 CSCL 17B

In reference to the overall scientific capability of a Mars 1971 multiple probe system, this study considers the restrictions placed on the system by the probe-to-bus transmission rate limits. These limits are determined by what is a feasible configuration of probe transmitter, probe antenna, probe radiated power, bus antenna, bus receiver, and bus storage capacity, as well as the communications geometry for each specific probe trajectory. Transmission rates were calculated for three cases. In the first case the first bus vehicle receives data from two probes, one impacting on the planet's dark side and the other landing toward midafternoon on the light side of the planet. For the worst case geometry, the calculations yield a transmission rate of 3000 bps. In the second, for the second bus, case the first probe impacts in the wave of darkening at 5°N and the second at 30° to 40°N and out of the wave of darkening. The calculation for this case gives a transmission rate of 7500 bps. The transmission rate computed for the third case, where each bus carries a single probe, was 12,000 bps. R.N.A.

N68-10168* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD SPACE FLIGHT CENTER MOBILE FM/FM TELEMETRY GROUND STATION H CAPABILITY REPORT
B. F. Karmilowicz Feb. 1967 58 p
(NASA-TM-X-63004; X-721-67-41) CSCL 09F

The functions and characteristics of the telemetry equipment of Goddard Space Flight Center's Mobile FM/FM Trailer, Ground Station H, are described.
Author

N68-10214# RAND Corp., Santa Monica, Calif.
THE MATHEMATICAL THEORY OF A STATIONARY QUEUE
A. Ia. Khinchin 23 May 1967 21 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 39, no. 4, 1932 p 73–84
(LT-67-19; TT-67-62063; AD-652833) CFSTI: HC $3.00/MF $0.65

The case of a single channel is treated under the assumption that the sequence of waiting times is stationary (in mean neither increasing nor decreasing) and the service times have an arbitrary distribution (with characteristic function psi(xi)). The relative lengths P(K) of the time intervals with K customers waiting is determined by recurrence formulas. Formula (5) gives the mean waiting time gamma; mu K signifies here the K-th moment of the distribution of waiting times and alpha denotes the traffic intensity. The formula for phi(xi) gives an expression for the characteristic function for the waiting time distribution. Finally, formula (9) gives the variance of the waiting times.
TAB

N68-10237*# Stanford Univ., Calif. Radioscience Lab.
THE REALIZABILITY OF A CODING SCHEME FOR ADDITIVE NOISE CHANNELS WITH FEEDBACK
Glen H. Smerage Apr. 1967 138 p refs
(Grant NsG-377)
(NASA-CR-90027; SU-SEL-67-027; SR-18) CFSTI: HC $3.00/MF $0.65 CSCL 09D

The realizability of Schalkwijk's coding scheme using feedback for bandlimited channels is studied. Transmission rates of 0.3 to 0.8 of channel capacity and error probabilities of 10^{-3} to 10^{-9} are achievable, generally with less than 10 iterations. For specified transmission rates the feedback code is significantly more reliable than existing one-way codes, often with less bandwidth. Of various feedback channels considered, a digital channel with 20-db signal-to-noise ratio is recommended. In addition, an analog-to-digital converter with up to 100 quantization levels is required at the receiver. The forward channel must be capable of providing peak power 16 to 50 times the average power. The feedback coding scheme is considered realizable and practicable; however, six requirements must be met for its application. Baseband and bandpass signaling schemes using amplitude modulation are proposed. Baseband detection at each terminal is accomplished with one matched filter. Transmitter and receiver block diagrams are specified.
Author

N68-10248* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MANNED SPACE FLIGHT NETWORK RADAR ANALYSIS REPORT
Apr. 1967 26 p
(NASA-TM-X-63008; X-552-67-192; Rept.-2) CSCL 17I

The analysis of the radars and associated equipment used for recording the high-speed magnetic tape data is presented. The following spacecraft and their launching dates during the winter of 1966–1967 are covered: lunar orbiter, February 5; GTA-12, November 11; Titan 3-C, January 18; Scanner L3-2843, December 10; Applications Tech Sat-B, December 7; Intelsat II (F-1), October 26; Intelsat II (-2), January 11; and Echo II tracked February 11. The pass by pass and the network analyses are outlined, and the data are tabulated.
N.E.N.

N68-10258# Worcester Polytechnic Inst., Mass. Dept. of Physics.
RECIPROCAL AND NONRECIPROCAL MICROSTRIP PERIODIC NETWORKS Final Report, Sep. 15, 1966–Jun. 15, 1967
Jerald A. Weiss 15 Jul. 1967 42 p refs
(Contract AF 19(628)-5167; ARPA Order 498)
(ESD-TR-67-482; AD-658488)

The report presents results of an investigation of a microstrip filter which wes designed for the study of nonreciprocal phase in S-band (about 3 GHz). Data are presented showing scattering, absorption, and nonreciprocity. The device is a low-pass comb filter. When matched to less than 1.1/1 VSWR over a 13% band, its insertion loss is 0.8 - 1.2 db. Nonreciprocal differential phase is frequency-sensitive, reaching 30 degrees near the cutoff frequency of 3.5 GHz. An analysis is presented of the theory of periodic networks with sufficient generality to include the nonreciprocal and nonconservative cases. Comparison with the performance of a reciprocal filter shows good agreement. The agreement with nonreciprocal effects is qualitatively correct, although a full treatment

of nonreciprocity must await a detailed field theory of propagation on microstrip with a magnetic substrate. The investigation shows that substantial amounts of nonreciprocal phase can be produced by means of a simple, compact, efficient microstrip structure with low loss and good match over an ample band, suitable for control in the latching (remanent) mode of operation. Author (TAB)

N68-10261# Washington Univ., Seattle. Dept. of Electrical Engineering.
HIGH GAIN LOG-PERIODIC ANTENNAS
Yung-sen Chen and Akira Ishimaru May 1967 43 p refs
(Contract AF 19(628)-5879)
(AFCRL-67-0325; TR-115; SR-1; AD-659382)

An experimental study was made of log-periodic antennas whose resonant elements are weakly coupled to the transmission line. Directive gains of more than 20 db over an isotropic radiator was obtained. Reasons for this higher gain are: (1) By the use of weak coupling and slowly tapered elements, the active region may be extended to any desired length; (2) Depending on the size of the structure, two or more active regions may be operated simultaneously. The measured performance of a magnetically coupled log-periodic antenna showed that the antenna characteristics are preserved with frequency. In addition, the design principles of this antenna are discussed and compared with experiment.
Author (TAB)

N68-10362* Collins Radio Co., Dallas, Tex.
ECHO II EXPERIMENTAL PROGRAM Final Report
15 Jul. 1965 233 p
(Contract NAS5-3640)
(NASA-CR-89620; Rept.-523-05568 18-001D3N) CSCL 17B

Ten communications experiments carried out using the Echo II satellite during 1964 are described in detail. Results of data reduction and analysis are included. The experiments comprised: measurements of received and instantaneous received signal levels, signal amplitude correlation measurements, wideband signal amplitude correlation measurements, signal phase correlation studies, audio frequency transmission testing, voice transmission tests, facsimile testing, digital data transmission, and space diversity reception studies. E.C.

N68-10378# Sandia Corp., Albuquerque, N. Mex.
ALGEBRAIC THEORY OF THE TWO-SIDED CORRELATION FUNCTION FOR BINARY CODES
G. J. Simmons Jun. 1967 28 p refs Presented at the Intern. Symp. on Inform. Theory, Athens
(Contract AT(29-1)-789)
(SC-R-67-1131; SC-DC-67-1612; CONF-670902-1) CFSTI: HC $3.00/MF $0.65

The algebraic properties of the two-sided correlation function are presented. The correlation operator is defined; algebraic characteristics are established in binary notation. The theory is directly applicable to problems where code choice is dependent on code correlation properties. Author (NSA)

N68-10406* Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
LM RELAY EXPERIMENT STUDY Final Report
9 Oct. 1967 158 p refs
(Contract NAS9-6893)
(NASA-CR-65784; Rept.-3347-3) CSCL 09F

The lunar module (LM) relay concept is defined as a system using synchronous satellites which (1) utilizes existing hardware, (2) is compatible with the existing Apollo communication system, (3) provides continuous coverage for orbital missions with moderate implementation and low operating costs, and (4) has growth capability for multiple spacecraft operation, extended range operation, and other relaying functions. Trade-off studies resulted in the selection of a dual coherent system which uses the relay to pass voice and data from the ground to the spacecraft, and to pass voice and telemetry from the spacecraft to the ground. The standard Apollo Block II ranging system and the S-band rendezvous ranging system are used. Preliminary system design details are given. Laboratory feasibility demonstrations are discussed, and laboratory interconnection and circuit diagrams are shown. Recommendations for improvements are proposed. M.G.J.

N68-10504* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AS-204 SIGNAL PREDICTIONS FOR UNIFIED S-BAND (USB)
Fred W. Kallmeyer Mar. 1967 14 p refs
(NASA-TM-X-63006; X-553-67-104) CSCL 17I

As a basis for a priori tracking analysis and marginal performance and/or signal dropout areas for the Manned Space Flight Network tracking equipment, predicted unified S-band signal levels for the AS-204 mission are presented. The mathematical model representing the spacecraft to ground station communications link is depicted. The procedures for signal level prediction are outlined in terms of determining spacecraft antenna gain, and computing signal levels. The signal levels are plotted as a function of time for both the surviving and nonsurviving antenna patterns onboard the spacecraft. From these figures, it can be determined a priori when to switch to the optimum antenna and also when marginal performance can be expected. It can also be determined that when the various signal levels are at or below threshold, voice and telemetry information may be marginal, thus indicating the use of another station with higher signal levels, or spacecraft orientation to a more favorable attitude. M.G.J.

N68-10521# Boston Coll., Chestnut Hill, Mass.
A THEORETICAL STUDY OF TROPOSPHERIC RADIOWAVE PROPAGATION Final Report, May 1963–Jan. 1967
Rose M. Ring Jan. 1967 47 p refs
(Contract AF 19(628)-2772)
(AFCRL-67-0112; AD-659421)

The report contains a theoretical study by mode theory methods of tropospheric radiowave propagation through a duct. A hyperbolic model is used for the duct. There are three different methods for carrying out the investigation. Characteristic values are given for the first four modes for nine different cases. Characteristic functions were computed for eight of these, for two different heights. Mode sums are given. The critical wave-length is considered.
Author (TAB)

N68-10530# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE SPEECH INTERFERENCE EFFECTS OF AIRCRAFT NOISE Final Report
C. E. Williams, K. N. Stevens, M. H. L. Hecker, and K. S. Pearsons Sep. 1967 78 p refs
(Contract FA-66-WA-1566)
(BBN-1487; FAA-DS-67-19)

Speech intelligibility scores and AI (Articulation Index) calculations were obtained as functions of time for aircraft flyovers and then used to establish the relation between AI and intelligibility for time-varying noise. A similar relation was obtained for steady-state simulated jet noise. Listeners of aircraft flyovers also rated the noise in terms of acceptability in the home in three listening situations: (1) in the presence of radio-TV speech; (2) in the absence of speech; and (3) in the presence of telephone speech. For situations when speech was present, the listeners were asked questions regarding the content of the speech. Judgments were compared with the maximum noise level occurring during the flyover. For a given noise level, little difference was observed between ratings obtained when speech was absent and ratings obtained with speech present at a comfortable level. For radio and

TV listening, there was a sharp drop in estimated sentence intelligibility when the peak noise level exceeded a perceived noise level of 88 PNdB, a SIL of 68 dB, or an A-weighted sound pressure level of 76 dB. Comprehension of verbal messages deteriorated appreciably when the peak noise level exceeded 86 PNdB. K.W.

N68-10615*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM NETWORK: GROUND COMMUNICATIONS RELIABILITY REPORT. SECTION I: MANNED SPACE FLIGHT NETWORK (MSFN). SECTION II: SATELLITE TRACKING AND DATA ACQUISITION NETWORK (STADAN)
Sep. 1963 76 p
(NASA-TM-X-60575; X-573-63-160, Sect. I; X-573-63-160, Sect. II) CFSTI: HC$3.00/MF$0.65 CSCL 17I

The operational reliability of the Manned Space Flight Network (MSFN) is analyzed, and evaluations are presented on both operational and composite reliabilities and one time-lost-by-trouble categories. Major trouble categories for the overall network are identified as line–cal le–microwave, equipment failure, and poor propagation. The reliability performance of several circuits are graphically depicted. An analysis of the Satellite Tracking and Data Acquisition Network (STADAN) performance shows that circuit interruptions occur largely at those stations or on those circuits involving radio links. Network reliability, outages by trouble categories, and circuit reliability are graphically presented. M.G.J.

N68-10675*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM NETWORK: GROUND COMMUNICATIONS RELIABILITY REPORT
Nov. 1966 79 p
(NASA-TM-X-60567; X-573-66-62) CFSTI: HC $3.00/MF $0.65 CSCL 17I

Reliability performance analyses are presented for the teletype circuits on an individual station/circuit basis, and as an integral network. Significant outage categories are identified as communications processor failure, poor propagation, interference, and power failure. Voice/data outage time and reliability indexes are tabulated and graphed, and analyses of high speed and wideband data circuits are included. M.G.J.

N68-10681 Joint Publications Research Service, Washington, D. C.
TWENTY-THIRD ALL-UNION SCIENTIFIC SESSION COMMEMORATING THE FIFTIETH ANNIVERSARY OF SOVIET POWER AND RADIO DAY
13 Nov. 1967 585 p refs Transl. into ENGLISH of the Publ. "XXIII Usesoyuznaya Nauchnaya Sessiya, Posuyashchennaya 50-Letiyu Sovetskoy Vlasti i Dnyu Radio" Moscow, 1967
(JPRS-43309; TT-67-33933) CFSTI: $3.00

In the monographs presented, attention is focused on the scientific and technological developments achieved by the Soviet Union in the fields of communication, data processing, automation, cybernetics, electronics, and the applications of radioelectronics in biology and medicine. Specific topics deal with information theory; antenna, waveguide, and semiconductor devices; multichannel electrical communication; automatic switching; television equipment and transmission; radio measurements; radio engineering; radio transmitters; radiowave propagation; radio broadcasting, electroacoustics, and sound recording; electronic computer equipment; telemetric data systems and telemechanics; microelectronics; discrete signal transmission theory and equipment; operations research; analog equipment and methods for solving boundary value problems; analog computer techniques and equipment; and fundamental trends in the field of electrical communication means. M.G.J.

N68-10697 Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 395, OVERALL STRUCTURAL DESIGN OF RADAR ANTENNA
Cheng-Jung T'ang 15 Nov. 1967 18 p Transl. into ENGLISH from Wu-hsien-tien-Chi-shu (Peking), no. 3, Mar. 1966 p 21–27
(JPRS-43333; TT-67-33957) CFSTI: $3.00

Overall structural design of antennas, structural design of reflector and reflector plane, and advances in antenna structure are treated for radar antenna. Mount rigidity to withstand wind, reduction as well as utilization of wind, antenna shielding, and installation of the antenna are noted; and calculation of reflector plane thermal deformation is included. M.W.R.

N68-10716# Page Communications Engineers, Inc., Washington, D. C.
HIGH ALTITUDE RADIO RELAY SYSTEMS Semiannual Report, 17 Aug. 1966–17 Feb. 1967
David Fales, Robert J. Lorence, Robert Hauptman, George L. Hesse, Ralph H. Gaze et al May 1967 344 p refs
(Contract DAAB07-67-C-0006; ARPA Order 694)
(ECOM-0006-1; AD-659400)

Theoretical and analytical investigations are aimed at determining the key characteristics and parameters of a system to enable the use of military communications equipment over difficult paths. The technique being investigated is the use of a radio relay installed in a high altitude platform, for the purpose of extending the range of remote area radio communications. The operational parameters considered were: traffic, transmission range, terrain, foliage, frequency range, modulation, and types of relay capabilities. The equipment parameters considered were: relay control, transmission modes, size and weight, radio frequency power levels, receiver sensitivities, power requirements, operational life, interference, jamming, platform performance, platform payloads, compatibility, basing, availability, and costs. The goal was to define the best relay-platform configurations for extending jungle communications ranges over difficult terrain. Within this context, the effort was one of synthesis, study, and selection of appropriate configurations, finalizing in a system design plan for implementation of the selected systems. TAB

N68-10729*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
A SPACE COMMUNICATIONS STUDY Final Report, 15 Sep. 1966–15 Sep. 1967
Kenneth K. Clark, Raymond L. Pickholtz, and Donald L. Schilling 15 Sep. 1967 210 p refs
(Grant NGR-33-008-020)
(NASA-CR-90095) CFSTI: HC$3.00/MF$0.65 CSCL 17B

This study principally covers transmission and reception of analog and digital signals through noisy media. A major portion deals with FM signals corrupted by addftive aussian noise and received through a fading medium, with focus on threshold extension. The maximum likelihood estimation problem for an analog FM signal lasting a fixed interval was solved using a digital computer. Two models characterizing the clicks of sub-optimum receivers are presented in conjunction with an analysis of the phase-locked loop. Studies using Fokker–Planck techniques were also performed. The output clicks of an FM receiver resulted in the occurrence of the threshold effect, and reduction of this effect is studied. Development of water tank channel simulator is discussed whose flexibility was extended to permit a wider variety in signal transmission through fading media. Detection, synchronization, and error rates of phase-shift keyed digital signals transmitted through noisy media were analyzed. Recursive detection of signals in noise is developed. Transmission media characteristics permit calculation of the likelihood function in terms of the most recent samples and a direct determination of optimum receiver performance under

various noise conditions. A wideband FM generator, limiters for FM signals in signal to noise ratio, and a statistical approach to multipath were investigated. K.W.

N68-10743*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM: MANNED AND SCIENTIFIC SATELLITE GROUND COMMUNICATIONS RELIABILITY REPORT FOR NASA COMMUNICATIONS NETWORK, SECTIONS I AND II
Jun. 1963 81 p
(NASA-TM-X-60571; X-563-63-160, Sect. I; X-563-63-160; Sect. II) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Separate tabular analyses of circuit reliability of the NASCOM networks (Manned Flight Communications Network and the Scientific Satellite Communications Network) are presented; the first analysis being made on the transmit path, and the second on the receive path of each of the several circuits. Teletypewriter performance data and a graphical analyses from the stations in the network are given, and are discussed. L.S.

N68-10744*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM NETWORK: GROUND COMMUNICATIONS RELIABILITY REPORT. SECTION 1: MANNED SPACE FLIGHT NETWORK (MSFN). SECTION 2: SATELLITE TRACKING A D DATA ACQUISITION NETWORK (STADAN)
Aug. 1963 77 p
(NASA-TM-X-60572; X-573-63-160, Sect. 1; X-573-63-160, Sect. 2) CFSTI: HC $3.00/MF $0.65 CSCL 17B

This report contains separate tabular analyses of circuit reliability of both Manned Space Flight Network (MSFN) and Satellite Tracking and Data Acquisition Network (STADAN); the first analysis being made on the transmit path, and the second on the receive path of each of the several circuits. Author

N68-10745*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM NETWORK: GROUND COMMUNICATIONS RELIABILITY REPORT. SECTION 1: MANNED SPACE FLIGHT NETWORK (MSFN). SECTION 2: SATELLITE TRACKING AND DATA ACQUISITION NETWORK (STADAN)
Jul. 1963 76 p
(NASA-TM-X-60573; X-573-63-160; Sect. 1; X-573-63-160, Sect. 2) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Network and circuit teletype reliability performance analyses for the Manned Space Flight Communications Network; and a network teletype performance analysis for the Satellite Tracking and Data Acquisition Network (STADAN) are presented. The performance of the stations involved in the networks are discussed, along with graphical analyses. L.S.

N68-10774* Houston Univ., Tex. Wave Propagation Lab.
LUNAR SURFACE BIAS ON LANDING MODULE ALTIMETER SIGNAL
A. Tong and H. S. Hayre Oct. 1967 10 p refs
(Contract NAS9-6760)
(NASA-CR-65795; TR-67-19) CFSTI: $3.00 CSCL 09F

The modulation system of the FM radar altimeter used in the Apollo landing module is described, and details are given on the mixing and filtering process. Equations are derived to show that a knowledge of the backscattering power permits an estimation of the lunar surface conditions in a probabilistic sense. The FM mean return spectrum is considered, and the beat frequencies are analyzed for each section of the trajectory because the altitude and both velocity components are varying. The results indicate the FM altimeter response may be analyzed to obtain the return energy level and the beat frequency during the Apollo landing. The return energy level, generally represented by the scattering coefficient, approximates the surface roughness, whereas the beat frequency is linearly proportional to the radar range. M.G.J.

N68-10796*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM NETWORK: GROUND COMMUNICATIONS RELIABILITY REPORT
Nov. 1963 78 p
(NASA-TM-X-60570; X-573-63-160) CFSTI: HC $3.00/MF $0.65 CSCL 17B

This report presents the significant results of an analysis of the performance and attained reliability of the NASCOM Network for the month of November 1963. Teletype, voice, and high-speed data circuits connecting Goddard Space Flight Center (GSFC) with the stations listed are evaluated with respect to their attained reliabilities. Author

N68-10821# France. Ministere de l'Air, Paris.
ANALYSIS OF A LOW FREQUENCY WAVE OF VARIABLE SELECTIVITY AND CONSTANT GAIN [ANALYSEUR D'ONDE BASSE FREQUENCE A SELECTIVITE VARIABLE ET A GAIN CONSTANT]
Henri-Pierre Berthoumieu Serv. de Doc. Sci. et Tech. de l'Armement 1967 82 p refs In FRENCH
(TN-159)

A detector was studied that permits the determination of the inlet direction of radioelectric whistlers as a function of frequency. The discrimination required between the components of the whistler necessitates a selective circuit of weak and variable passband along with a system of modulated frequency. The selected circuit should have a constant gain. Transl. by M.W.R.

N68-10824# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
RADAR CROSS SECTIONS FOR TOTALLY REFLECTING SPHERES
Larry O. Christian Aug. 1967 41 p refs
(ECOM-5142; AD-659327)

The backscatter efficiency factors (radar cross section divided by geometrical cross section) for totally reflecting spheres have been calculated using exact Mie theory. The results are presented both in tabular and graphical form for the size parameter (circumference of sphere divided by wavelength of incident radiation) range from 0.01 to 19.95 in increments of 0.01. Comparison between these theoretical calculations and experimental measurements shows very close agreement (less than 4.4% difference) in five of seven cases. Author (TAB)

N68-10842# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.
ANTENNA SYSTEM OPTIMIZATION BY TRANSCOHERENCE FUNCTION MAXIMIZATION: APPLICATIONS
G. O. Young and A. A. Ksienski Dec. 1966 168 p refs
(Contract AF 19(628)-4358)
(P67-29; AFCRL-67-0168; SR-3; AD-659139)

The concept of transcoherence function maximization for antenna system optimization is demonstrated by means of examples. These include the optimization of planar apertures subjected to both random and nonrandom fields from single and multiple point-sources; the determination of the optimum spacing of elements in a direction-finding interferometer array located in a random medium; the space-time optimization of a linear radar; and the optimization of systems in the presence of stationary random media. Finally, the optimization technique is applied to the problem of an antenna

embedded in a nonstationary medium, such as the hot plasma that would surround a space vehicle antenna during the reentry phase. The amplitude and phase shading of such an array are the variable parameters chosen for optimization of the system, and medium effects, background (object) noise, receiver noise, etc. are considered. Author (TAB)

N68-10846# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.

ANTENNA SYSTEM OPTIMIZATION BY TRANSCOHERENCE FUNCTION MAXIMIZATION: THEORY

G. O. Young and A. Ksienski Dec. 1966 91 p refs

(Contract AF 19(628)-4358)

(P66-196; AFCRL-67-0150; SR-2; AD-659138)

A definition of the transcoherence or transcorrelation function and the meaning of the degree of coherence are presented. The transcoherence function is derived for a general information-carrying field. Classical optical coherence theory is discussed, and the relationship between the classical definitions and the coherence functions defined in this report is derived. It is shown that first order coherence theory can describe gaussian processes, but that a higher order theory is necessary for nongaussian functions. Such a higher order theory is then developed. The relationship between information theory and the transcoherence function for space-time information-carrying systems, such as antenna processing systems, is presented. Maximization of the transcoherence function is shown to be equivalent to maximization of the space-time information content at the output, relative to the desired input. Related subjects such as stationarity, ergodicity, regression, and estimation are also discussed. Author (TAB)

N68-10860# European Space Vehicle Launcher Development Organization, Paris (France). Studies and Exptl. Work Div.

A DECOUPLED SHIFTING MEMORY FILTER METHOD FOR RADIO TRACKING OF SPACE VEHICLES

R. Cosaert and E. Gottzein Mar. 1967 91 p refs Presented at the 18th Intern. Astron. Congr., Belgrade, 24–30 Sep. 1967

(ELDO-TM-F5) CFSTI: HC $3.00/MF $0.65

The method presented is tailored for boosted phases of flight. It is guaranteed against divergence and demands a uniform computational load both per measurement sample interval, which is small compared to the load of Kalman or least square fit methods that are equivalent in accuracy. In addition, the method facilitates analysis of sensitivity to poorly known model parameters and preliminary computer load requirements. However, it only applies when three position and three velocity components are measured. Author (ESRO)

N68-10870*# Adcom, Inc., Cambridge, Mass.

OAO DATE TRANSMISSION STUDY Final Report, Feb. 10–Jul. 25, 1967

Edward P. Greene 1967 75 p refs

(Contract NAS5-10509)

(NASA-CR-90109; G-93) CFSTI: $3.00 CSCL 09F

A study was conducted to estimate the compressibility of playback spacecraft data handling equipment (SDHE) telemetry data from future OAO satellites and to develop an implementation plan for processing and transmitting the compressed SDHE telemetry data from the data acquisition stations supporting the OAO project to the OAO control center at GSFC. Three configurations for the SDHE data compression and transmission were evaluated. The specifications of the most promising configuration are given and its performance is analyzed in terms of operational procedures, equipment constraints, and message formats. The study showed that data compression can reduce the time required to transmit playback SDHE data from a remote site to GSFC. Assuming 100 minutes between successive SDHE playback commands, the entire SDHE message can be compressed, transmitted, and reconstructed at GSFC in an estimated 11 minutes using the selected configuration and procedure. If the SDHE data is not compressed at the remote site, 65 minutes would be required for the transmission of the message to GSFC. R.N.A.

N68-10894*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ACQUISITION OF APOLLO USING THE 12' ENTRY SHIP USB-SYSTEM

J. R. Moore Jul. 1966 32 p refs

(NASA-TM-X-63022; X-507-66-326) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The capability of the S-Band equipment installed on reentry ships to acquire an Apollo spacecraft in an earth orbit trajectory is reviewed. Attention is given to modification possibilities assuming VHF equipment were removed from the spacecraft. When the reentry ship is not stationed on the trajectory ground track, the trajectory will cross the search pattern at an angle other than zero degrees with the main axis, resulting in a decrease in tavel time in the beam and probable reduction in detection capability. The following methods for improving acquisition by increasing the speed of frequency search are examined: passive search with existing tracking filter, frequency spectrum analyzer on radiated signal, broadband receiver to cover range of frequencies, broad beam acquisitions antenna, and multivertical lobe antenna matrix. E.C.

N68-10920# Mitre Corp., Bedford, Mass.

DESIGN CONSIDERATIONS FOR FORWARD ERROR CONTROL EQUIPMENT FOR HF RADIO

Kenneth Brayer Aug. 1967 28 p refs

(Contract AF 19(628)-5165)

(MTR-362; ESD-TR-67-356; AD-659162)

The national range division (NRD) presently operates high-speed (2400 bits/sec) HF communication links to transmit data back to the Cape Kennedy complex from down range stations such as Ascension Island. Due to the high error rates normally experienced on these HF channels, error correction must be implemented to improve communication. This report deals with the design of an error controller within the constraints of the NRD communications environment. Author (TAB)

N68-10936*# Communication Systems, Inc., Falls Church, Va.

PRECIPITATION SCATTER INTERFERENCE BETWEEN SPACE AND TERRESTRIAL COMMUNICATION SYSTEMS

F. J. Altman 16 Oct. 1967 56 p refs

(Contract NASw-1216)

(NASA-CR-90108; Rept.-453340) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The transmission loss is calculated which may be expected from precipitation scatter between earth stations in the space service and microwave radio-relay stations sharing the same frequency band. The geometrical and meteorological factors are developed, including many approximations which permit use of the meager available data to provide rough but valuable siting criteria. It is shown that low altitude beam intersections in most climates give rise to low losses which may cause harmful interference and therefore should be considered in the coordination procedure. The effects of sidelobes may be taken into account in the non-intersecting cases by avoiding intersections of the earth-station beam axis, and cylinders with radii of about six miles centered on the radio-relay station beam axes. Further weather radar data on reflectivity profiles of storms, especially in the tropics, are urgently needed. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-10127*# Maryland Univ., College Park. Computer Science Center.
DETECTION AND SCALING OF STATISTICAL DIFFERENCES BETWEEN VISUAL TEXTURES
Peter H. Stoloff Sep. 1967 129 p refs
(Grant NsG-398)
(NASA-CR-90033; TR-67-51) CFSTI: HC $3.00/MF $0.65 CSCL 09B

An investigation of the perception of visual textures in which the statistics of a single local property are controlled is reported. Of specific interest is the problem of whether there are comparable scales of subjective estimation of different local properties. Two local properties were used: number of dots and shape. In the first case, the simple patterns were clusters of dots; in the second case, they were shapes formed by two perpendicular line segments. The experiments consisted of two parts, a detection study and a scaling study. Five subjects participated in the detection study. The task was to detect similarities and differences between the pairs of simultaneously presented textured patterns. A second set of displays was generated at a large visual angle, in order that subjects could scale similarities of the pairs of stimuli. The results are discussed with respect to the psychological space of structuredness, and the consequences of scaling perceptually different local properties in the same multidimensional space. C.T.C.

N68-10144*# Texas Univ., Austin. Electronics and Related Science Research Labs.
ON THE STRUCTURE OF SEQUENTIAL MACHINE REALIZATIONS
Charles A. Harlow and Clarence L. Coates 19 Jul. 1967 78 p refs
(Grants NGR-44-012-049; NSF GP-2724; NSF GK-1146X; AF-AFOSR-766-66)
(NASA-CR-90051; TR-27) CFSTI: HC $3.00/MF $0.65 CSCL 09B

In most studies of the structure of sequential machines there has been a tacit assumption that the machine was to be realized with unit delay memory elements. In this report we consider the sequential machines that are realized with either trigger or set-reset flip-flop memory elements. It is shown that the relation called a partition pair which predicts the dependence of the input functions to unit delay memory elements does not predict the dependence of the input functions to trigger or set-reset flip-flop memory elements. In this paper we define relations called t-pairs and r-pairs which characterize the dependence of the input functions to trigger and set-reset flip-flop memory elements respectively. It is found that these relations do not have all the algebraic properties that partition pairs possess. Author

N68-10204* Control Technology, Inc., Long Beach, Calif.
SIMULATION ERROR COMPENSATION TECHNIQUES, PHASE 3 Final Report
A. S. Jackson 1 Aug. 1966 71 p refs
(Contract NAS9-4587)
(NASA-CR-65788) CSCL 09B

A study was made of techniques for reduction of dynamic error in computer simulation involving analog computers or digital differential analyzers (DDA). Attention was focused on the use of feedforward compensation and loop gain compensation. The study was restricted to the consideration of analog and DDA simulation of linear second order loops. Results of both characteristic root error analysis and time domain simulation experiments are presented. Both methods of compensation were found to be very effective in reducing dynamic errors, particularly for small values of system per unit critical damping. From a practical viewpoint, either method of compensation is somewhat difficult to implement for analog simulation because of the very small gains required. Implementation of these compensation techniques does not seem to be a real problem for DDA simulation. Author

N68-10205* Control Technology, Inc., Long Beach, Calif.
EXTENSION OF THE APPLICATION OF THE Z-TRANSFORM CALCULUS TO ANALYSIS OF INCREMENTAL COMPUTERS (TRICE DDA), PHASE 2 Final Report
R. V. Morse 1 Aug. 1966 76 p
(Contract NAS9-4587)
(NASA-CR-65787) CSCL 09B

A detailed analysis of the constant multiplier element of the TRICE was performed which yielded techniques for obtaining exact z-transforms of this element based on aperiodic output pulse trains and application of recursive difference equation techniques. The concept of an average z-transform representation was developed to put the resultant family of rigorous z-transforms into more useable form. The initial value in the TRICE R register and the polarity of the quantity added to that register were found to have an important effect on the delay associated with TRICE elements. To analyze the TRICE integrators, a digital simulation was performed of a typical second order loop interconnection. The results were then compared with those predicted from z-transforms. The effects of register length, amplitude of the oscillation and initial value in the R register were studied. The study was extended to the generation of rules for the derivation and interpretation of z-transform type representations of non-linear operations. The overall results of the study of linear elements validates the use of conventional z-transforms for representation of incremental computing provided that certain potential error sources are properly handled. Author

N68-10206* Control Technology, Inc., Long Beach, Calif.
ANALYSIS OF DYNAMIC SIMULATION ERRORS FOR COUPLED LOOP MODELS, PHASE I Final Report
A. S. Jackson and C. R. Shuler 1 Aug. 1966 60 p refs
(Contract NAS9-4587)
(NASA-CR-65786) CSCL 09B

An assessment of the effects of coupling on the dynamic simulation errors resulting from use of the digital differential analyzer (DDA), the electronic differential analyzer (EDA) and a hybrid combination of the two types of computers is reported. The assessment is concerned only with simulation of simple linear second order loops coupled in both position and velocity. The principal objective was to find out over what ranges of coupling coefficients the dynamic errors would be in substantial agreement with those predicted from study of a single second order loop. A by-product of the study was a better understanding of the displacement of the characteristic roots caused by coupling. Results of this study indicate that single loop characteristic root error analysis can be used quite effectively to predict root errors for both the DDA and analog simulation cases. Single loop error analysis is not nearly as effective for predicting the errors experienced with hybrid (EDA-DDA) simulation, although good correlation is found at the low frequencies inherent in real-time simulation of aerospace problems. Finally, it was concluded that combined EDA-DDA simulation is of questionable value as an aid in improving high frequency accuracy unless the precision available with the DDA is a limiting factor. Author

N68-10209* Control Technology, Inc., Long Beach, Calif.
PROCEDURES FOR MORE EFFECTIVE UTILIZATION OF THE RAYTHEON 440 COMPUTER IN HYBRID SIMULATION, PHASE 4 Final Report

A. S. Jackson and J. D. Wallin 1 Aug. 1966 82 p refs
(Contract NAS9-4587)
(NASA-CR-65789) CSCL 09B

A set of guidelines for more efficient utilization of the Raytheon 440 computer in the simulation of re-entry type aerospace vheicle models in a laboratory where both analog computers and a parallel digital differential analyzer are linked to the digital computer are developed. The study of various functions which the digital computer could perform and an assessment of the effect using the digital computer for those functions in each case on the overall simulation loop dynamic errors are included. The results indicate that time delay of the digital computer is a limiting factor on obtainable accuracy if the digital computer is included in a loop with either the DDA or analog computer. The various computational aspects of the six-degree-of-freedom re-entry model were investigated from the standpoint of the implementation and computational time in order to assess the time delays involved. Investigation of the integration aspects of the model included a study of seven different numerical integration methods. The time domain errors resulting from the study indicate that the fourth-order Runge–Kutta method of integration was by far the most efficient method covered in this study. Author

N68-10270# RAND Corp., Santa Monica, Calif.
GRAPHICAL AIDS TO AEROSPACE VEHICLE MISSION ANALYSIS
B. W. Boehm and J. E. Rieber Oct. 1967 13 p refs Presented at the Am. Inst. of Aeron. and Astronautics, 4th Ann. Meeting and Tech. Display, Anaheim, Calif., 23–27 Oct. 1967
(P-3660; AD-659352)

This paper describes an interactive computer graphics system, called Graphic ROCKET, currently being developed as a performance analysis aid for the aerospace vehicle systems analysis process. It is intended to provide a means for rapidly specifying and evaluating the performance of a wide range of aerospace vehicle designs and flight plans. This capability will enable the aerospace mission analyst either to get his job done much faster or to consider a larger number of alternatives for accomplishing his mission objective. Author (TAB)

N68-10386* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.*
SPAN RECORDING FORMAT AND DATA REDUCTION PROGRAM
Apr. 1967 21 p
(NASA-TM-X-63010; X-552-67-206) CSCL 09B

The digital magnetic tape recording format used to record real time Solar Particle Alert Network (SPAN) parameters is described. Also included is a description of the SPAN data reduction program which uses the Fortran Assembly Program for data input and manipulation, and Fortran II for output. The output of the program is a continuous printout of the SPAN parameters contained on the magnetic tape. R.N.A.

N68-10412# California Univ., Berkeley. Dept. of Mathematics.
PATTERN RECOGNITION, FUNCTIONALS, AND ENTROPY
Hans J. Bremermann Aug. 1967 26 p refs
(Contracts Nonr-3656(08); Nonr-222(85))
(AD-659197)

Pattern recognition (including sound recognition) is described mathematically as the problem to compute for any element of a given class its image in a classification set. The difficulty lies in the fact that the map may be implicitly defined by a property or must be extrapolated from prototypes. An entropy measure and an equivocation measure are defined that permit an assessment of the improvement gained (and the price in confusion paid) by a set of features. Linear features are identified as measures and L superscript 2 functions respectively. It is shown that certain important normalizations (position, size, pitch, etc.) are non-linear operations. Finally, the method of spectral analysis which is widely used for speech analysis is examined critically. It is shown that contrary to common belief Fourier analysis is not very suitable for detecting certain speech particles (consonants, stops, etc.). Author (TAB)

N68-10430# System Development Corp., Santa Monica, Calif.
A NOTE ON PRESERVATION OF LANGUAGES BY TRANSDUCERS
Seymour Ginsburg and Gene F. Rose 23 May 1967 11 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(TM-738/032/00; AFCRL-67-0364; SR-6; AD-657016)

An error in a previous paper is corrected. The rectified version involves pushdown transducers with accepting states instead of pushdown transducers. Some properties of pushdown transducers with accepting states are then noted. TAB

N68-10459# System Development Corp., Santa Monica, Calif.
ABSTRACT FAMILIES OF LANGUAGES
Seymour Ginsburg and Sheila Greibach 17 Apr. 1967 60 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(TM-738/031/00; AFCRL-67-0363; SR-5; AD-657015)

The notion of an abstract family of languages (AFL) as a family of sets of words satisfying certain properties common to many types of formal languages is introduced. Operations preserving AFL are then considered. The concept of an abstract family of acceptors (AFA) is also introduced and shown to give rise to an AFL. A necessary and sufficient condition on an AFL is presented in order that the AFL come from some AFA. Finally, abstract families of transducers (AFA with output) are discussed. Author (TAB)

N68-10542# Oregon State Univ., Corvallis. Computer Center.
NEBULA COMPUTER Progress Report, 1 Jan. 1966–2 Aug. 1967
J. A. Boles, V. L. Cheeves, J. N. Haak, G. A. Hoselton, B. L. Rogoff et al 21 Aug. 1967 37 p refs
(Contract Nonr-1286(11))
(CC-67-8; AD-659304)

Oregon State University has designed and constructed a medium speed, serial digital computer using glass delay lines circulating at 22 mc. as memory. The design objectives as originally conceived in a special seminar were: (1) To be a research project in computer design. (2) To be used as an educational machine. (3) To have easily modifiable hardware for basic research in computer systems design. An unusual arrangement of information within the 22 mc. memory allows a simple interface with the 340 kc. arithmetic unit, which results in an effective zero latency time and provides possibilities for an associative memory. The arithmetic unit has a command structure similar to large parallel machines and uses flip-flop arithmetic and control registers throughout. All hardware development has been aimed toward the concept of easy modification, elaborate console controls for effective man–machine interaction, and low cost. This report describes the status of the project as of August 21, 1967. Author (TAB)

N68-10557# Brookhaven National Lab., Upton, N. Y.
MAN–MACHINE COOPERATION IN DIGITAL PATTERN RECOGNITION OF BUBBLE CHAMBER TRACKS
R. C. Strand Jun. 1967 36 p refs Presented at the Conf. on Data Extraction and Process. of Opt. Images in the Med. and Biol. Sci., New York Sponsored by AEC
(BNL-11572; CONF-670635-1) CFSTI: HC $3.00/MF $0.65

Conventional bubble chamber data extraction and processing and semiautomatic data extraction, which uses part manual track recognition and part computer track recognition, are discussed. The design and implementation of the track recognition programs are also discussed. NSA

N68-10576# Naval Weapons Lab., Dahlgren, Va.
A STRETCH COMPUTER PROGRAM TO SUMMARIZE HERO TEST DATA
Rannie W. Royal Oct. 1967 46 p
(TM-K-60/67; AD-659474)

A detailed description is given for an IBM 7030 computer program designed to summarize HERO test results. A flow chart of the program, FORTRAN IV listing and samples of input and output configurations are given. Author (TAB)

N68-10618# Kafafian (Haig) Associates, Washington, D. C.
A STUDY OF DISCRETE PROPAGATION-BASED MODELS FOR PICTORIAL PATTERN ANALYSIS Final Report, 1 Jun. 1966–31 May 1967
Azriel Rosenfeld, John L. Pfaltz, and Haig Kafafian 30 Jun. 1967 89 p refs
(Contract AF 19(628)-5949)
(AFCRL-67-0467; AD-659158)

This report describes algorithms for computing various functions on a digital picture which depend on the distance to a given subset of the picture. The algorithms involve local operations which are performed repeatedly, in parallel, on every picture element and its immediate neighbors. Applications to the detection of clusters and regularities in a picture, and to the dissection of a region into pieces, are also described. The medial axis transforms (skeletons) resulting from the various distance-dependent functions are compared, with particular regard to noise sensitivity. Author (TAB)

N68-10654# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
MIMIC: A DIGITAL SIMULATOR PROGRAM
R. J. Cullen and G. L. Lechliter 15 May 1967 59 p
(Contract W-31-109-ENG-52)
(KAPL-M-6708) CFSTI: HC $3.00/MF $0.65

A digital computer program, MIMIC, is described for solving systems of ordinary differential equations on a CDC-6600 computer with the SCOPE 2.0 operating system. MIMIC was written to provide those engineers and scientists who do not have backgrounds in computer techniques with a simple but effective means of communicating with a digital computer, yet the language is flexible enough to appeal to the professional programmer, either analog or digital. MIMIC is an advanced version of an earlier computer program called MIDAS. The execution time is very problem dependent. A typical second order model would run in <20 seconds. Author (NSA)

N68-10665* Midwest Research Inst., Kansas City, Mo.
MULTIPLE PRECISION COMPUTATIONS ON THE IBM-360 Interim Technical Report
Yudell L. Luke and Duncan I. Sommerville 14 Aug. 1967 39 p
(Contract NAS8-20403; MRI Proj. 2959-P)
(NASA-CR-89962) CSCL 09B

A listing is presented of the multiple precision subroutine source programs for the IBM 360, which were written for use when the double precision capability available with Fortran IV does not provide sufficient accuracy. The multiple precision package uses two double words to store each multiple precision number, which contains 29 significant decimal digits and ranges from 10^{-127} to 10^{127}. The numbers are read, written, and otherwise manipulated by calling various routines in the package with the variables to be manipulated as arguments. Instructions are given for storage allocation, input–output, and arithmetic statements. Also included is a numerical example used to test features of the package, which computes the Bessel functions of a given argument for orders 0,1,2,... by use of the backward recurrence formula. M.G.J.

N68-10680# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics.
IMPLICIT PROJECTION IN COMPUTER PRINT-OUTS
William Warntz 15 Sep. 1967 24 p
(Contract Nonr-00014-67A-0298)
(AD-659457)

The use of high-speed electronic digital computers for the computation and the use of their printers, plotters, and scopes for the graphical portrayal of various kinds of map projections is now well established. In this paper, the presence of implicit or built-in, but hitherto ignored, projections in the various sizes of character space print-outs for the standard computer printers is considered. Author (TAB)

N68-10720# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USING AN APM-1 PRINTER AT THE COMPUTER OUTPUT [PRIMENENIYE PECHATAYUSHCHEY MASHINKI APM-1 USTROYSTVAKH VYVODA VYCHISLITEL'NYKH MASHIN]
V. Ye. Khodakov 8 Mar. 1967 10 p Transl. into ENGLISH from Avtomat. i Proborostr. (Kiev), no. 2, 1965 p 31–33
(FTD-HT-66-493; TT-67-62988; AD-659264)

The development and test results of the first Soviet on-the-fly printer APM-1 are reported. The high-speed line printer uses a continuously rotating print wheel carrying 24 characters; they are selected by a 5-digit binary code. Fast-acting hammers print the characters. The printer is connected to the computer via a control unit which comprises ferrite-diode logical elements and semiconductor amplifiers. Functional and principal circuits of this unit are presented and their operation is briefly explained. During the two-year operation of an APM-1 on-the-fly printer prototype, no failure of a major component occurred. TAB

N68-10739*# LTV Aerospace Corp., Dallas, Tex. Astronautics Div.
COMPARATIVE EVALUATION OF LTV COMPUTER ROUTINES
C. W. Hixon and J. L. Gaddis 13 Sep. 1966 15 p
(Contract NAS9-2772)
(NASA-CR-65741; TR-00.847) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Seven computer routines currently in use: (1) interruption and restart, (2) checkout printing, (3) steady state shutdown and jump ahead, (4) laminar or turbulent flow heat transfer, (5) laminar or turbulent flow pressure balance, (6) parallel or simple banks and headers flow, and (7) fluid freezing, are descriptively summarized. A table of the various flow and heat exchanger options, and several special options available to the user, is presented. These routine options are also briefly described. Accuracy, run time, available data space, and problem size requirements are discussed. L.S.

N68-10797 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
SAHYB-2: A PROGRAMME FOR THE SOLUTION OF DIFFERENTIAL EQUATIONS USING AN ANALOGUE-ORIENTED LANGUAGE
H. d'Hoop and R. Monterosso Brussels EURATOM Sep. 1967 94 p
(EUR-3622.e) CFSTI: $3.00

Many programs and sub-programs exist for the integration of differential equations. Nevertheless for the study of practical cases (as encountered in nuclear reactors simulations) their use is subject to many restrictions, or needs an important programming effort. SAHYB-2 is derived from the experience of a previous program SAHYB-1, and is designed to be used by physicists or engineers who are not specialists in programming. In particular it is addressed to analogue computation engineers who need an

easy way to obtain digital solutions to be compared with analog results. The problem description is concentrated in one sub-routine for intial value problems and in two sub-routines for boundary value problems. Other sub-routines are already prepared to handle operations such as: Output of results, Modification of integration and/or print-out step; Interpolation of tabulated functions; fixed or variable delays; Plot of curves on CALCOMP plotter. The existing versions are for the IBM 7090 and the IBM 360/65 computers. Author

N68-10865# College of Aeronautics, Cranfield (England).
THE "TURBOCODE" SCHEME FOR THE PROGRAMMING OF THERMODYNAMIC CYCLE CALCULATIONS ON AN ELECTRONIC DIGITAL COMPUTER
J. R. Palmer Jul. 1967 53 p
(COA-AERO-198) CFSTI: HC $3.00/MF $0.65

The "Turbocode" scheme for programming thermodynamic cycle calculation on an electronic computer is described in terms of the Ferranti "Pegasus" version. The structure and general mode of operation of the scheme is described in the main body of the report, while details of the major program segments and their specifications, the methods of programming and the method of running a Turbocode program are given in appendices. Author

N68-10998# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
RELATION BETWEEN INFORMATION REGISTERED AND THE COORDINATES OF THE LABORATORY IN EXPERIMENTS INVOLVING SPARK CHAMBERS [RELAZIONI TRA LE INFORMAZIONI REGISTRATE E LE COORDINATE DI LABORATORIO IN ESPERIMENTI DEL TIPO CON CAMERE A SCINTILLE]
G. Sette (Genoa Univ.) and G. Verri 5 Sep. 1967 17 p refs In ITALIAN *Its* Nota Interna No. 380
(LNF-67/62) CFSTI: $3.00

Some relationships are discussed between the information collected by scintillation counters and the spatial coordinates of the laboratory in which the experiments are being conducted. Subroutines for programming the geometric problems related to the data collected are considered, and a printout is presented. Calculations are included for parallax compensation.
Transl. by M.W.R.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-10062# France. Ministere de l'Air, Paris.
ON THE FREQUENCY STABILIZATION OF A BF OSCILLATOR BY A CONTROL METHOD. APPLICATION TO THE REALIZATION OF A FREQUENCY MODULATION OSCILLATOR HAVING A DYNAMIC LIFT [SUR LA STABILISATION EN FREQUENCE D'UN OSCILLATEUR BF PAR UNE METHODE D'ASSERVISSEMENT. APPLICATION A LA REALISATION D'UN OSCILLATEUR MODULABLE EN FREQUENCE AYANT UNE DYNAMIQUE ELEVEE]
Pierre Delepine Serv. de Doc. Sci. et Tech. de l'Armement, 1967 75 p refs In FRENCH *Its* No. NT 160

Operation of a frequency-modulated oscillator by a control loop subjected to a variable capacity diode was studied. Signal to noise ratio was improved, which resulted in increased data transmission capability in the frequency band considered. The search for a correction network resulted in the stability of the control loop with an elevated index and frequency of modulation, as shown by an analytical and experimental study of the system. The prototype model functioned according to predictions. Transl. by M.W.R.

N68-10074# California Univ., Berkeley. Electronics Research Lab.
STUDY OF CROSSED-FIELD AMPLIFIERS Quarterly Progress Report, 16 Sep.–15 Dec. 1966
K. A. Fox, R. Y. C. Ho, M. A. Meyer, S. Swierkowski, C. W. Turner, et al Apr. 1967 21 p refs
(Contract DA-36-039-AMC-02164(E))
(ECOM-02164-15; QPR-14; AD-658200)

Topics included are: Low-noise crossed-field microwave amplifier; Crossed-field shielded-cathode electron gun studies; Cathode region studies; Crossed-field acoustic-wave interaction; Crossed-field electromagnetic interactions in semiconductors. TAB

N68-10148# Rex Corp., West Acton, Mass.
STATUS OF POLYMONOTRIFLUOROCHLOROETHYLENE INSULATED WIRE
L. A. Walters [1967] 5 p
(AD-656319)

Additional measurements with the experimental TE sub n11 monotron oscillator are described. Probing of the radiation from the uranium glass window at the end of the device has resulted in the observation of new oscillation frequencies. Measurements of the rf output spectrum are described. Design of an improved version of the monotron oscillator is discussed. The design changes being considered included changes in drift-tube and cavity length and diameters, reduction in beam thickness, and the introduction of mode control methods to improve coupling to the output waveguide. Author (TAB)

N68-10202# Varian Associates, Palo Alto, Calif.
INVESTIGATION OF ELECTRONIC INTERACTION WITH OPTICAL RESONATORS FOR MICROWAVE GENERATION AND AMPLIFICATION Quarterly Report, 16 Dec. 1966–15 Mar. 1967
Howard Jory Jul. 1967 18 p
(Contract DA-28-043-AMC-01873(E))
(Rept.-341-8Q; Rept.-8; ECOM-01873-4; QR-4; AD-659443)

Additional measurements with the experimental TE sub n11 monotron oscillator are described. Probing of the radiation from the uranium glass window at the end of the device has resulted in the observation of new oscillation frequencies. Measurements of the rf output spectrum are described. Design of an improved version of the monotron oscillator is discussed. The design changes being considered included changes in drift-tube and cavity length and diameters, reduction in beam thickness, and the introduction of mode control methods to improve coupling to the output waveguide. Author (TAB)

N68-10242# Navy Electronics Lab., San Diego, Calif.
THE MULTITHROW MICROWAVE DIODE SWITCH Research and Development Report, Aug. 1963–Aug. 1965
J. Reindel 16 Jun. 1967 34 p refs
(NEL-1468; AD-659285)

A microwave diode switch was designed and built as part of a program to develop a high-power, broadband, single-pole, 32-throw switch for use with a 32-port, L-band linear array antenna. The microwave diode switch was recommended for use in agile-beam IFF systems. Author (TAB)

N68-10256# Sandia Corp., Albuquerque, N. Mex.
NEUTRON RADIATION DAMAGE IN SILICON TRANSISTORS
C. A. Goben, F. M. Smits, and J. L. Wirth Aug. 1967 42 p refs
(Contract AT(29-1)-789)
(SC-RR-67-312) CFSTI: HC $3.00/MF $0.65

From a study of base and collector current as a function of the emitter-to-base voltage, it was found that neutron-induced base current has components originating in the emitter space charge region as well as the neutral base region. At low injection levels the neutron-induced base current is dominated by the space charge component, whereas the high injection behavior appears to be controlled by recombination in the neutral base region. Additional experiments performed in special tetrode transistors and van der Pauw-type samples indicate that changes in collector current are dominated by recombination in the neutral base, while changes in base doping and mobility have only a secondary effect. These conclusions are reached from experiments on transistors with a ring emitter, on tetrode-type test transistors, and on special Hall-effect devices. Author (NSA)

N68-10263# Army Electronics Labs., Fort Monmouth, N. J.
MICROWAVE TRANSISTOR INTERMEDIATE-FREQUENCY AMPLIFIER (2GHz)
Vladimir Gelnovatch, Ivan L. Chase, and Thomas F. Burke Jul. 1967 19 p refs
(ECOM-2853; AD-659336)

A method of designing microstrip amplifiers is presented. Transmission line measurements for the transistors are converted to obtain the Z, Y, h, etc., parameters, and maximum available gain at the frequency of interest is then determined. Coupling networks are computed in the form of simple series L- and C-type structures, and width over height (W/h) as a function of frequency is determined. Using these techniques, the fabrication of two amplifiers is described and their performance data are shown. Author (TAB)

N68-10276# Sandia Corp., Albuquerque, N. Mex.
ANALYSIS OF RADIATION EFFECTS IN SEMICONDUCTOR JUNCTION DEVICES
C. W. Gwyn, D. L. Scharfetter, and J. L. Wirth Jul. 1967 59 p refs Presented at the Nucl. and Space Radiation Effects Conf., Columbus, Ohio, 10–14 Jul. 1967
(Contract AT(29-1)-789)
(SC-R-67-1158; CONF-670708-3) CFSTI: HC $3.00/MF $0.65

A computer program was written for the prediction of transient and permanent radiation damage in junction devices. This program calculates the transient solutions of Poisson's Equation and the continuity equations throughout a one-dimensional structure. Mobility, lifetime and carrier generation are described by nonlinear functions of carrier density and current so that scatter limiting velocity, Shockley–Read–Hall recombination and avalanche ionization phenomena are described. Three examples are presented which illustrate the utility of such programs in predicting both ionization and displacement damage effects in a P-I-N diode and a bipolar transistor. Author (NSA)

N68-10282# Avco Corp., Lowell, Mass. Space Systems Div.
UNDERWATER ELECTRODELESS SPARK SOUND SOURCE Annual Technical Report
Hubert A. Wright, Jr. 10 Oct. 1967 40 p ref
(Contract Nonr-4389(00))
(AVSSD-0359-67-CR; AD-659534)

The research discussed in this report was concerned with: device modifications intended to reduce secondary, device-scattered emissions, exploration of low energy (20-50 joule) discharges, the effects of gas dissolved in the electrolyte, and bubble pulse suppression. The dominant source of device-scattered emissions was an internal reflection. A configurational change greatly reduced this effect. The acoustic output of the low-energy electrodeless spark discharge is a single-polarity pulse of one- to two-microsecond duration which has a peak pressure at one yard of up to 100,000 d sq cm. The low energy discharge is extremely reproducible and capable of operation in electrical parallel with other electrodeless spark sources without detrimental mutual interaction. The use of degassed electrolytes greatly reduces the gas evolved and eliminates the need, in many instances, for forced electrolyte circulation. The bubble-pulse peak pressure can be suppressed with low energy discharge, to at least 20 db below the peak pressure of the primary pulse. Retention of a sufficient remnant voltage following high energy (thousands of joules) discharges is difficult; as a result, effective automatic bubble pulse suppression is relatively difficult with high energy discharges. Author (TAB)

N68-10413# Japan Broadcasting Corp., Tokyo. Television Research Div.
TELEVISION STANDARDS CONVERTER USING DELAY-LINE SYSTEM
Haruo Sakata, Hiroshi Tanimura, and Ryuichi Kaneko Aug. 1967 16 p refs *Its* Ser. No. 111
CFSTI: HC $3.00/MF $0.65

Direct television picture conversion using a delay-line system is being developed to improve picture quality over that obtained with image-transfer systems. Both two-way conversion and color signal conversion are under consideration; with conversion being between 625/50 and 525/60 standards. Principle of the television standards converter are discussed, along with the designed equipment and its performance. M.W.R.

N68-10420*# Melpar, Inc., Falls Church, Va.
THIN-FILM PERSONAL COMMUNICATIONS AND TELEMETRY SYSTEM (TFPCTS)
Washington NASA Nov. 1967 33 p
(Contract NAS9-3924)
(NASA-CR-914) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The final electrical design of the Thin-Film Personal Communications and Telemetry System (TFPCTS) is proposed and discussed. A block diagram of the entire system is depicted, along with diagrams of the transmitter, receiver, and thin-film universal very high frequency modules. Project scheduling is described; and a PERT chart showing the module delivery data is given. Module processing information and mask drawings for the first IF module, are also given. L.S.

N68-10464# Simplex Wire and Cable Co., Cambridge, Mass.
APPENDIX OF TABLES AND CHARTS FOR "ADVANTAGES AND LIMITATIONS OF INSULATED WIRE AND CABLE"
R. E. Gross, G. A. Snow, and H. R. Stoddard [1967] 7 p
(AD-656511) CFSTI: HC $3.00/MF $0.65

The physical, mechanical, and electrical properties of aluminum which are of principle interest to the wire and cable industry are presented in tabular and graphic form. Comparison is made, where applicable, to copper and lead. TAB

N68-10517# Army Electronics Labs., Fort Monmouth, N. J.
NUVISTOR TRIODE, TYPE 8058
William G. Muessle Mar. 1967 37 p
(ECOM-2810; AD-659342)

Tests were conducted on the nuvistor triode, type 8058, to determine its capabilities for military application. Data are presented for static characteristics, power gain, noise figure, input admittance, cross modulation, and rf power output. Author (TAB)

N68-10583# Radio Corp. of America, Somerville, N. J.
IMPROVEMENT OF LOW-TEMPERATURE FIELD-EFFECT TRANSISTORS Final Technical Report, 22 Apr. 1966–22 Jan. 1967
R. H. Dawson and F. Moench, Jr. Griffiss AFB, N. Y. RADC Sep. 1967 61 p refs
(Contract AF 30(602)-4223)
(RADC-TR-67-124; AD-659453)

A low-temperature (4.2 K) MOS amplifier was developed that exhibited a transconductance of 8 millimhos and an amplification factor of 400 at a power dissipation of 150 microwatts. The transconductance is close to the objective value of 10 millimhos, while the amplification factor far exceeds the objective of 10. Noise figures over the bandwidth from 3 hertz to 5 kilohertz, however, were far greater than the objective value of 2 db. The lowest noise figures obtained at liquid helium temperatures were about 40 db at 100 hertz and about 20 db at 5 kilohertz. A source resistance of 1/G sub m was used in the calculations. The low-frequency spectral intensity of noise exhibited a 1/f distribution, in agreement with theory. Noise figures at liquid helium temperatures were about 15 db, which was higher than expected. The equivalent input noise voltage was reduced by a factor of four in one case. It was determined that an inversion-layer channel exists at 4.2 K for effective gate voltages greater than zero. This layer, however, is strongly influenced by drain-to-channel feedback capacitance. When the effective voltage is less than zero, conduction is by space-charge-limited current. These factors explain the observed triode-like I-V characteristics (rather than the normal pentode-like characteristics) at liquid helium temperatures. The tetrode (cascode of two triodes) yields effective pentode characteristics that result in high amplification with equivalent triode noise. Author (TAB)

N68-10584# Varian Associates, Palo Alto, Calif.
INVESTIGATION OF ELECTRONIC INTERACTION WITH OPTICAL RESONATORS FOR MICROWAVE GENERATION AND AMPLIFICATION Quarterly Report, 16 Sep.–15 Dec. 1966
Howard Jory Ft. Monmouth, N. J. Army Electron. Comm. Jul. 1967 25 p
(Contract DA-28-043-AMC-01873(E))
(Rept.-341-Q; ECOM-01873-3; Rept.-7; QR-3; AD-659442)

Changes in the magnet system for the experimental monotron oscillator are described. These changes have resulted in the disappearance of rf output at frequencies harmonically related to the accelerator frequency and in the appearance of rf output at two new frequencies. This output is described and evidence is presented to indicate that it is the result of oscillations of the type expected. However the oscillations appear to involve a section of drift tube as a resonator rather than the actual millimeter wave cavity. Calculations are described which employ a digital computer to determine the electron trajectories in a TE sub n11 cylindrical cavity. The calculations indicate that significant bunching occurs as a result of the E theta field and that the bunch can be placed in a decelerating phase by making the beam angular velocity be less than that of the wave. Author (TAB)

N68-10589# Army Electronics Labs., Fort Monmouth, N. J.
MICROWAVE SOLID-STATE DEVICES AND CIRCUITS
Frank A. Brand and Vladimir Gelnovatch Jul. 1967 41 p refs
(ECOM-2864; AD-659417)

The progress and state-of-the-art in the areas of microwave solid-state devices and circuits are presented. Treated specifically is the performance of most solid-state devices, both available and predicted. The microwave aspects of integrated circuits are examined tutorially and a number of examples presented. Author (TAB)

N68-10622# European Organization for Nuclear Research, Geneva (Switzerland).
DAMAGING ELECTRONIC SYSTEMS BY RADIOACTIVE RADIATION (RADIATION DAMAGES IN TRANSISTORS) [GEFAEHRDUNG ELEKTRONISCHER SYSTEME DURCH RADIOAKTIVE STRAHLUNG (STRAHLENSCHAEDEN IN TRANSISTOREN)]
A. Steinemann [1966] 36 p refs In GERMAN; FRENCH summary *Its* ABC Bull. No. 10
(NP-16772)

Sensitive electronic systems can be damaged by intense γ, β, and neutron radiations. They are then taken out of service with immediate or delayed effect (latency time). Such phenomena were observed in the vicinity of nuclear reactors. The tolerance doses for transistors is approximately at fluxes of 10^{16} neutrons/cm^2 10^{15} electrons/cm^2, or 10^{15} γ quanta/cm^2. The human doses that can be compared to these tolerance values approaches 10^9 rem (n) or 10^7 (γ) if they are calculated for the fission energies of N and γ. The irradiations tolerated for transistors are several orders of magnitude above the lethal dose for humans. In the military domain, the survivors of a nuclear explosion will always find intact electronic devices. The damaging of the electronic devices by the radiation from radioactive fall-out is improbable, since normalized values of γ radiation of 1_1 (γ) $\geq 10^5$ r/hr are necessary. The dangers of damages caused to military electronic apparatus during a war is almost zero and can not be considered as an obstacle to the use of transistors on a large scale. The physical effects produced by radioactive radiation in the transistors can be compared to the effects produced in living tissues. If the enormous differences in the order of magnitude are neglected, the qualitative comparison of the effects (solid state–living tissue) shows great analogies. Author (NSA)

N68-10658# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE EFFECTS OF IONIZING RADIATION ON TRANSISTORS
D. P. Peletier Aug. 1967 64 p refs
(Contract NOw-62-0604-c)
(TG-937; AD-659295)

An experiment, in which 15 npn bipolar silicon transistors were exposed to Co60 gamma radiation, is described. The known theory concerning the radiation damage of transistors is presented. In addition, the distinguishing characteristics of ionizing radiation damage are discussed, and a method of estimating bulk damage is developed. During the experiment, the following transistor parameters were measured: AC and DC common emitter current gain, collector-to-base leakage current, gain-bandwidth product, and base spreading resistance. The damage curves for leakage current and AC and DC common emitter current gain are plotted and discussed. The relation between transistor parameter degradation and bias current is investigated by dividing the transistors into three equal groups and biasing them at three different collector levels during irradiation. The recovery of leakage current is plotted and an exponential curve fitted to the data. Recovery time of current gain is qualitatively observed. Data indicate that in some transistors damage to leakage current peaks near an accumulated radiation dose of 100,000 rad. The value of this peak is as large as 300 times the final damage value. The recovery time constant of leakage current damage is less than 15 minutes for the transistors tested. Author (TAB)

N68-10673# Naval Radiological Defense Lab., San Francisco, Calif.
HIGH RANGE GAMMA RADIAC DEVELOPMENT. AMPLIFIER DESIGN FOR USE WITH SMALL SILICON DIODE DETECTORS
Walter F. Joseph 28 May 1967 27 p refs
(USNRDL-TR-67-106; AD-659282)

Low cost silicon diode detectors for use in a high range (1 R/h to 10,000 R/h) gamma radiac were investigated and a computer program developed for processing energy response data. A simple low cost amplifier using bipolar transistors was designed for use with the diodes. Bipolar transistors are shown to be the best active elements for this purpose by the theoretical methods developed during this investigation. Author (TAB)

N68-10695 Joint Publications Research Service, Washington, D. C.

MICROMODULES USED IN UNIT DESIGN OF SHIP RADIOELECTRONIC EQUIPMENT

N. N. Rodionov 7 Nov. 1967 16 p refs Transl. into ENGLISH from Sudostr. (Moscow), no. 5, May 1967 p 44–50
(JPRS-43274; TT-67-33898) CFSTI: $3.00

Reliability, repairability, and operational conditions are among the factors considered during the development of microunits for shipboard radioelectronic equipment. Forming the electrical connection between the microunits themselves and with the micromodule is discussed, as is the procedure for making the printed circuit assembly. Design of the micromodule for manufacturing under mass production conditions stresses simplicity; and use of photochemical and photoelectrochemical methods and a combination of the two for circuit board manufacture is noted. M.W.R.

N68-10717# Syracuse Univ. Research Corp., N. Y. Defense Systems Div.

A HIGH DUTY CYCLE, HIGH PERFORMANCE LOG VIDEO AMPLIFIER

Paul E. Harris 15 Aug. 1967 39 p refs
(Contract Nonr-4686(00))
(DSD-TM-181; AD-659494)

Most high performance log video amplifiers are restricted to a pulse train duty cycle of 5 per cent or less. The circuit herein described can readily accommodate duty cycles in excess of 50 per cent. This is accomplished by an improved DC restorer incorporating an operational amplifier. Additional attributes of the circuit are wide dynamic range (approximately equal to 90 dB), high sensitivity (approximately equal to 90 dB below 1 volt), and wide bandwidth (rise-time approximately equal to 150 ns). The circuit has been deliberately put in an operational amplifier format so that certain standard integrated circuit modules might be used. Diodes act as logging elements in a two stage feedback network. The transfer function may be adjusted to correct for limitations in the square law range of microwave detector crystals. Partial temperature compensation is provided. Author (TAB)

N68-10718# Montana State Coll., Bozeman. Electronics Research Lab.

DESIGN AND DEVELOPMENT OF ROSSI OSCILLATORS AND MIXERS Monthly Progress Report, Jun. 1–Jun. 30, 1967

Jun. 1967 10 p refs Prepared for Calif. Univ., Livermore
(Contract W-7405-ENG-48)
(UCRL-13304; MPR-12) CFSTI: HC $3.00/MF $0.65

Transistorized Rossi oscillators were developed to operate at fixed specified frequencies with less than 2% distortion over an output range of 2 to 22 W at a 50 Ω load level. Suitable ground quartz crystals oriented for an AT-cut were used. The crystals do not require a temperature controlled oven to maintain the required frequency accuracy. At 2, 5, and 10 MHz, the crystals operate in the fundamental mode. At 20, 40 to 50, 80 to 100, and 200 MHz, the crystals operate in a series mode, 3rd overtone. Improved Rossi mixers were also developed with one unit covering frequencies of 2, 5, 10, 20, 40, 80, 100, and 200 MHz, and a second unit covering 333.333, 400, and 500 MHz. Each unit contains an attenuator to provide control of the Rossi signal level, suitable traps to block the sweep signal from the Rossi signal line, traps to block the Rossi signal from the sump generator circuits and a tuned circuit to provide impedance transformation. NSA

N68-10733# Electro-Optical Systems, Inc., Pasadena, Calif.

CHARGE-CONTROLLED STORAGE DISPLAY PANELS Quarterly Technical Report, 1 Apr.–30 Jun. 1967

P. Foote, B. Kazan, and J. Winslow Oct. 1967 34 p ref
(Contract DA-28-043-AMC-02482(E))
(ECOM-02482-4; QR-4; Rept.-4; AD-659418)

During the fourth quarter the performance and characteristics of current image storage panels were evaluated. Also, work was initiated on development of techniques for fabrication of large-area panels on single substrates. The loss of stored images due to both frontal excitation of the panel by room light and optical feedback from the electroluminescent layer to the photoconductive layer was investigated and, to a great extent, eliminated. The voltage dependence of the panels transfer characteristic was measured. Resolution measurements were made on a 12-inch, 50-line/inch image panel. Factors influencing the uniformity and speed of panel erasure were also studied. In the area of technique development for large-area, single-substrate panels, several approaches were investigated. One approach involved formation of the panel electrode structures on acrylic plastic coated with a transparent conducting film of tin oxide. The usefulness of cadmium oxide as a transparent conductor on plastic and glass substrates was also investigated. A dual-conductor arrangement for electrode lines was devised and preliminary tests made. A new panel structure employing continuous electrodes instead of interdigitated electrodes was also studied. Author (TAB)

N68-10868# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.

INVESTIGATION OF SYNCHRONOUS-WAVE R-F TO D-C CONVERSION Triannual Report No. 3, Feb. 1–May 31, 1967

D. C. Watson, K. I. Talbot, C. C. Johnson, and R. W. Grow Sep. 1967 26 p ref
(Contract DA-28-043-AMC-02290(E))
(UTEC-MD-67-042; ECOM-02290-3; AD-659345)

A gun-collector tester, in which r-f power is simulated, was constructed and tested, and the experimental results compared with theoretical predictions. In the gun-collector tester, deflection plates were used to put orbital motion on the beam. The equations of motion for an electron in the deflection plate region were solved to obtain the ratio or orbital energy to longitudinal energy on the beam. Experimental tests were conducted to verify the correctness of the derived relation. Further experimental tests demonstrated that the conversion efficiency of the gun-collector tester is significantly greater than that of previous converter tubes, though still short of the theoretical capability. In gun tests, the perveance was found lower than expected, but a smooth beam could be obtained. It was concluded that the higher conversion efficiency can be attributed to two factors: (1) The collector has been nickel-plated, thus reducing the problem of secondary emission and (2) the transition length of the magnetic field is longer, which for a vanishing magnetic field predicts the higher efficiency theoretically. The derived relation for ratio of orbital energy to longitudinal energy was also verified experimentally. Though gun perveance was low, corrective action is being taken to improve it somewhat. Author (TAB)

N68-10882 Institut für Plasmaphysik G.m.b.H. Garching (West Germany).

ELECTRONIC AUXILIARY DEVICES FOR THE 2.6 MJ-THETA PINCH [ELEKTRONISCHE HILFSGERAETE FUER DIE 2,6 MJ-BATTERIE]

U. Seidel Sep. 1967 14 p refs In GERMAN; ENGLISH summary Supported in part by EURATOM
(IPP-1/71) CFSTI: $3.00

Electronic circuits are described, developed for the purpose of safe handling and controlling mega-joule theta pinches. In case one or several spark-gaps of the condenser bank break down

prematurely, uncontrolled triggering of other spark gaps is likely to occur; this might bring damage for part of the condenser bank. To prevent this a circuit was developed which automatically fires the whole bank if any spark-gaps break down prematurely. This device also registers these groups of the bank where uncontrolled breakdown occurred. Another circuit was designed to control different functions of a series of oscilloscopes. It can give a reset-pulse to a prefixed number of oscilloscopes; it can make a selected number of scopes write a bottom line; and it shows if all oscilloscopes are in the ready-state. The main advantage of this device is that all oscilloscopes are controlled from one unit. A circuit for a plug-in unit is given, which permits writing two independent simultaneous signals on a single trace up to a deflection speed of 0.1/usec/cm, without influencing the signal-to-noise ratio. Author

N68-10917*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DECONTAMINATION, CLEANING, COATING AND ENCAPSULATION OF ELECTRONIC CIRCUIT BOARDS
Francis N. Ledoux Dec. 1965 14 p Revised
(NASA-TM-X-55997; X-723-66-12) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Procedures are outlined for cleaning, decontamination, conformal coating, and encapsulation of electronic circuit boards and electrical connectors for use on the IMP's D&E spacecraft. These procedures are to ensure decontaminated and/or microbial-free components for assembly and integration into the prototype and flight units of the spacecraft. Definitions applicable to the procedures, documentation requirements, and inspections are also listed. K.W.

N68-10964# California Univ., Berkeley. Electronics Research Lab.
STUDY OF CROSSED FIELD AMPLIFIERS Quarterly Progress Report, Dec. 16, 1966–Mar. 15, 1967
K. A. Fox, R. Y. C. Ho, M. A. Meyer, S. Swierkowski, C. W. Turner, et al Aug. 1967 25 p
(Contract DA-36-039-AMC-02164(E))
(Rept.-16; ECOM-02164-16; QPR-15; AD-659328)

The work on the crossed-field potential minimum fluctuations yielded the important conclusion that cathodes must be shorter than about 0.6 of a cycloid length to avoid instabilities and, therefore, excess noise. Also simple formulae were found for the potential minimum static characteristics. The flattened helix appeared to be a good choice of circuit for a low-noise tube because of the high interaction impedance. Limitations on minimum reasonable electrode size and available power supplies prevented raising the cathode current density higher than about 0.27 amperes/sq cm (more space-charge smoothing was achieved with higher current). It appeared to be possible to find smoother self-consistent fields and, therefore, simpler electrodes than those calculated by Rao in his initial design of the magnetically shielded crossed-field gun. Initial analytic estimates of the heat flow in a laser excited cathode were based on a one-dimensional model. They indicated that sufficient power should be obtainable from an argon laser to obtain interesting beam currents. Analysis of the interaction between drifting charge carriers and electromagnetic waves in InSb indicates that, for thin slabs, growing waves can be expected. The case of crossed magnetic field on an acoustic wave interaction in InSb is expected to lead to amplification at frequencies into the microwave range. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-10092*# Midwest Research Inst., Kansas City, Mo.
GENERALIZED RATIONAL APPROXIMATIONS WITH APPLICATIONS TO PROBLEMS IN CONTROL THEORY Interim Technical Report
Wyman Fair and Yudell L. Luke 14 Aug. 1967 13 p refs
(Contract NAS8-20403)
(NASA-CR-89974) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A technique is presented for obtaining formal rational approximations to the solution of matrix Ricatti equations for use in describing the behavior of solutions both locally and globally. The matrix Ricatti equations include systems of linear differential equations as a special case. Author

N68-10125 Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
LYAPUNOV FUNCTIONS FOR NONLINEAR TIME-VARYING SYSTEMS
Kumpati S. Narendra and James H. Taylor Aug. 1967 34 p refs
(CT-13)

For a quite general class of dynamic systems having a single memoryless time-varying nonlinearity in the feedback path some frequency domain stability criteria are developed using Lyapunov's second method. Several classes of nonlinearities are considered, and it is seen that as the behaviour of the nonlinearity is restricted, the stability conditions are relaxed. Most of the results for time invariant nonlinearities have been previously obtained [2,3,4], but many of the results for time-varying nonlinear systems as well as those theorems for a new class of nonlinearity are original with this report. Author

N68-10153# Wisconsin Univ., Madison. Dept. of Statistics.
OPTIMAL CONTROL WHEN THE VARIANCE OF THE MANIPULATED VARIABLE IS CONSTRAINED
G. E. P. Box and G. M. Jenkins (Lancaster Univ., Eng.) Mar. 1967 26 p refs
(Contract AF-AFOSR-1158-66)
(TR-108; AD-656683)

Discrete feedback control schemes discussed by Box and Jenkins were designed to produce minimum mean square error in the output. It was tacitly supposed that there was no restriction in the degree of manipulation that could be applied to x sub t the input or manipulated variable to achieve this. It sometimes happens that we are not able to employ these optimal schemes because the amount of variation which can be allowed in the input adjustments x sub t is restricted by practical limitations. It is considered, therefore, how the previous control schemes would need to be modified if a constraint was placed on V(x sub t) the variance in the input. Such modified schemes are of considerable practical importance because unrestricted schemes can call for excessively large values of V(x sub t). TAB

N68-10211# Information Research Associates, Inc., Lexington, Mass.
ON THE LINEAR AND QUADRATIC DISCRIMINATORS FOR PATTERN RECOGNITION
Poduri S. R. S. Rao 21 Jul. 1967 18 p refs
(Contract Nonr-4752(00))
(IRA-TR-12; IRA-100:20; AD-659296)

In this report, two problems in pattern recognition are considered: (1) When the likelihood ratio criterion results in a quadratic discriminant function, it may be possible to factor the quadratic form into two linear discriminant functions. It is shown that the probabilities of misclassifications are the same for both the linear discriminant functions and that both of them should be used for classification. (2) When the likelihood criterion results in a linear discriminant function, it is shown that the estimate of the 'squared distance' has a positive bias and hence the probability of misclassification is underestimated. Author (TAB)

N68-10213 Ministry of Technology, London (England). Technical Information and Library Services.
STATISTICAL THEORY OF GRADIENT SYSTEMS OF AUTOMATIC OPTIMISATION WITH ONE AND TWO TEST STEPS AND THEIR COMPARATIVE ANALYSIS [K STATISTICHESKOI TEORII GRADIENTNYKH SISTEM AVTOMATICHESKOI OPTIMIZATSII S DVUMYA I ODNIM PROBNYMI SHAGAMI I IKH SRAVNITELNYI ANALIZ]
N. G. Gorelik 1967 14 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (USSR), v. 6, 1966 p 99–107
(TIL/T-5734)

One-dimensional gradient systems of automatic optimization with one or two test steps with input noise are considered. It is assumed that input noise consists of white noise and steady noise with known correlation function and the extremum slowly drifts along the X axis. Analysis of concrete systems of automatic optimization is given. Author

N68-10241# Aerospace Corp., El Segundo, Calif. El Segundo Technical Operations.
LONG LIFE DIGITAL ATTITUDE CONTROL SYSTEM: ESTIMATE OF COMPUTATIONAL REQUIREMENTS
William K. Clarkson Apr. 1967 56 p refs
(Contract AF 04(695)-1001)
(TR-1001(2307-13); SSD-TR-67-136; AD-659163)

The report is the second in a series aimed at determining the requirements and configuration for a long-life satellite attitude control system in which all logic and computation functions are performed in a time-shared general purpose digital computer. The purpose of this report is to derive accurate estimates of the requirements imposed upon the digital computer by the attitude control equations. A programming specification based on these equations is first presented. Based on that specification, estimates of the computational requirements of the attitude control task are derived in terms of required memory storage and computation speed for typical spaceborne computers. The attitude control program is found to require 877 instructions and 226 words of data storage. This requirement represents 9.3 percent of the storage capacity of a Univac 1824 or 13.5 percent of the capacity of an IBM 4 pi computer. The computation speed requirement is estimated to be 24,300 equivalent adds/sec, which represents 19.4 percent of the 1824s speed capability, or 12.2 percent of the capability of the 4 pi. It is therefore concluded that the appreciable advantages in weight, power, and reliability resulting from the use of an available general purpose digital computer for satellite attitude control can be achieved at a very reasonable cost in terms of computer utilization. Author (TAB)

N68-10247# Polytechnic Inst. of Brooklyn, N. Y.
INVARIANT ESTIMATION OF STOCHASTIC SYSTEM PARAMETERS
L. Shaw and G. Robinson (Middle East Tech. Univ., Ankara) 17 Jun. 1967 6 p refs Presented at Intern. Federation of Autom. Control Symp., Prague, 12–17 Jun. 1966; Sponsored by AROD
(AROD-5211-4; AD-656953)

Invariant estimators for the parameters of autoregressive schemes are developed. The invariant estimates have not been shown to yield the minimum conditional risk attainable by invariant estimators. (Note that there need not be a unique constant risk estimator for a given class of cost functions.) Futher work on this problem may show that these estimators are indeed optimal or may show how to improve them to get estimators with smaller constant conditional risks. Author (TAB)

N68-10301 Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, NUMBER 4
6 Nov. 1967 310 p refs Transl. into ENGLISH from Tekhn. Kibernetika (Moscow), no. 4, Jul.–Aug. 1967 p 1–301
(JPRS-43249; TT-67-33873) CFSTI: $3.00

Articles on control problems, queueing and reliability theory, pattern recognition, automata, and automatic control are presented. For individual titles see N68-10302–N68-10327.

N68-10302 Joint Publications Research Service, Washington, D. C.
INFORMATION ASPECTS OF INDUSTRIAL PROCESS CONTROL
B. N. Petrov, I. D. Kochubiyevskiy, and G. M. Ulanov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 1–18 refs (See N68-10301 01-10)

On the basis of the concept introduced here (the distinguishability threshold of states of the object of control) the general conditions of industrial process control using the principles of information theory are analyzed. The general system for control of an object realizing an industrial process is described. The control reduces to two problems: stabilization and reproduction. It is demonstrated that stabilization of the state in a given region, which is the basis for any control, may be interpreted as restricting the variety of possible states. The industrial process control limits are always limited by the carrying capacity—the controllability of the object carrying out the industrial process. Author

N68-10303 Joint Publications Research Service, Washington, D. C.
TRANSFORMATIONS OF VARIATION PROBLEMS
A. D. Ioffe *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 19–33 refs (See N68-10301 01-10)

The general result of the preceding work by this author is used to investigate some special cases. Restrictions are indicated on the region of applicability of the optimalness principle of V. F. Krotov; and one-dimensional optimal control problems are considered. The basic theorem for them is generalized to the case where the control space is not bounded. Author

N68-10304 Joint Publications Research Service, Washington, D. C.
ASYMPTOTIC ESTIMATES OF THE RATE OF CONVERGENCE OF RANDOM SEARCH
E. M. Vaysbord *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 34–49 refs (See N68-10301 01-10)

The asymptote of the mathematical expectation of the time that a global extremum will reach a given vicinity is given by the method of random search with a noise intensity approaching zero. The asymptote for the rate of convergence of distribution of the position of a random point at the time t to limiting distribution is also obtained. Results are obtained for the case of search for the extremum of functions of one independent variable and for certain special cases the functions of many independent variables. The results obtained may be used in the construction of optimizers. Author

N68-10305 Joint Publications Research Service, Washington, D. C.
STOCHASTIC OPTIMIZATION OF PARAMETERS BY THE METHOD OF VARIATION OF THE SEARCH REGION
N. V. Khovanov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 50–60 refs (See N68-10301 01-10)

A mathematical model is presented which is widely used when describing organic evolution and the psychology of knowledge processes of selective choice among blind variations. The convergence of a special case of this process is considered, the algorithm of which is realized by the network of binary elements and may serve for optimization of the parameters of a technical system, information about the transfer function of which is strongly limited. Author

N68-10306 Joint Publications Research Service, Washington, D. C.

A MULTICHANNEL QUEUEING SYSTEM WITH GROUP ARRIVAL OF DEMANDS

L. M. Abol'nikov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 61–73 refs (See N68-10301 01-10)

This article contains an investigation of the problem of queueing an irregular flow of demands by a system consisting of n homogeneous channels. The problem is among the queueing problems with delay. The generating function of the probabilities that one number or another of demands will be in the system is found. An algorithm is proposed for finding the probabilities in the stationary condition. The average queue length and the law of distribution of the delay time before beginning servicing are found. In conclusion, a practical interpretation of the given mathematical model is presented. Author

N68-10307 Joint Publications Research Service, Washington, D. C.

AN APPROACH TO THE PROBLEM OF STATISTICAL EVALUATION OF SYSTEM RELIABILITY

V. A. Ivnitskiy *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 74–85 refs (See N68-10301 01-10)

The reliability function of a complex highly reliable system is considered. On the basis of the property of asymptotic normality of the sample times and the form of the reliability function expanded in a series with respect to the small parameter (the intensity of failure) of the elements of a complex system, fiducial intervals are constructed for the reliability of this system with respect to the results of tests run on its elements. Another approach is also discussed to the solution of the inverse problem: determination of the volume of tests which must be run on each element of a complex system to evaluate its reliability with given accuracy and validity (that is, for a given fiducial interval). Author

N68-10308 Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE QUANTITATIVE INFLUENCE OF VARIOUS FACTORS ON THE INTENSITY OF FAILURE OF ELEMENTS OF AUTOMATIC SYSTEMS

Ye. I. Vorob'yev and Yu. L. Solov'yev *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 86–92 refs (See N68-10301 01-10)

A procedure is proposed for the definition of separate influence of various factors on the intensity of failure of elements of automatic systems. A comparison of the number of failures characterizing the reliability of the various groups of single-type elements and the duration of effect of the investigated factors on the indicated groups is used in this procedure. Author

N68-10309 Joint Publications Research Service, Washington, D. C.

A PROCEDURE FOR INVESTING THE RELIABILITY OF COMPLEX LOGICAL CONTROL SYSTEMS BY THE METHOD OF STATISTICAL SIMULATION

B. B. Buyanov, L. B. Groysberg, S. M. Domanitskiy, V. M. Ozernoy, Ye. D. Kharlamova et al *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 93–99 refs (See N68-10301 01-10)

A procedure is proposed for statistical simulation of complex logical control systems based on a combination of accelerated simulation with direct analysis of the consequences of failures of elements and ensuring with the help of a series of tests that we obtain all the required reliability characteristics for various versions of structure of the system. An example of investigation of the reliability of the complex logical control system is considered. Author

N68-10310 Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF CORRELATIONS BETWEEN ATTRIBUTES ON THEIR INFORMATIVENESS FOR PATTERN RECOGNITION

A. G. Frantsuz *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 100–106 ref (See N68-10301 01-10)

The informativeness of the group consisting of two normally distributed attributes which are strongly modulo correlated is compared with the informativeness of the individual attribute. Qualitatively and quantitatively it is demonstrated that in the general case the informativeness of the group increases essentially. Special cases are presented which are exceptions to this rule. Author

N68-10311 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF A TYPE OF SYNCHRONOUS AUTOMATION

Ye. A. Gurvits *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 107–120 refs (See N68-10301 01-10)

A class of synchronous automata with memory is considered. A model of an automaton with several synchronizing inputs is described. To record the conditions of operation of the automata the language of transfer tables is used. A procedure is investigated for obtaining the minimum number of internal states. Possible application of polysynchronous automata and examples are also considered. Author

N68-10312 Joint Publications Research Service, Washington, D. C.

OPTIMAL SCHEDULING OF PROCESSING OF PARTS ON THREE SEQUENTIAL MACHINES

B. A. Vlasyuk *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 121–130 refs (See N68-10301 01-10)

This article contains an investigation of the problem of optimal scheduling of processing of parts on three sequential machines. To find the sequence which minimizes the total processing time the method of dynamic programming is used. Author

N68-10313 Joint Publications Research Service, Washington, D. C.

AN ALGORITHM FOR CHECKING THE CONNECTEDNESS OF A GRAPH

I. A. Ushakov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 131–133 refs (See N68-10301 01-10)

An algorithm is proposed for definition of connectedness based on expansion of the set of vertices connected with any arbitrary initial vertex with an increase in the number of sides in the chains connecting these vertices. Author

N68-10314 Joint Publications Research Service, Washington, D. C.

CONSIDERATION OF THE CHARACTERISTICS OF THE ELEMENTS WHEN CONSTRUCTING COMBINATION SYSTEMS

Ye. A. Drozdov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 134–147 refs (See N68-10301 01-10)

Problems of taking the switching time and input and output coefficients of logical elements into account in the formation of combination systems with given values of individual parameters were investigated. The basic computation relationships and the general algorithm for optimization of systems are presented and their use is illustrated by examples. Author

N68-10315 Joint Publications Research Service, Washington, D. C.

CONVERSION OF A DIGITAL CODE INTO VOLTAGE USING INCREMENTAL INTEGRATION

G. Kh. Babich and V. V. Bel'giy *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 148–161 (See N68-10301 01-10)

The principle of conversion of digital code into voltage with incremental integration of the transformed quantity with respect to its preceding value is proposed. The conversion circuit is described and analyzed with analog-digital feedback. A frequency analysis of the procedural errors in the conversion is presented. Author

N68-10316 Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF SYNTHESIS OF AUTONOMIC CONTROLS

T. A. Letova *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 162–177 refs (See N68-10301 01-10)

A method of synthesis of autonomic optimal controls is discussed. The method is based on the method of dynamic programming and the concept of optimalness of a closed system. Author

N68-10317 Joint Publications Research Service, Washington, D. C.

THE INVERSE PROBLEM OF SYNTHESIS OF OPTIMAL CONTROL

A. G. Aleksandrov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 178–188 refs (See N68-10301 01-10)

Expressions are obtained in explicit form which relate the parameters of the given control law of an asymptotically stable linear system with the coefficients of a nonnegative quadratic functional for the selection of which this control law is optimal. The formalism of the solution of the inverse problem for nonlinear systems is presented. The results obtained are used for the solution of the inverse problem of synthesis of a gyroframe regulator. Author

N68-10318 Joint Publications Research Service, Washington, D. C.

THE METHOD OF STATISTICAL OPTIMIZATION OF NONLINEAR PULSE AUTOMATIC CONTROL SYSTEMS

A. Ya. Andriyenko *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 189–204 refs (See N68-10301 01-10)

A method is proposed for statistical optimization of nonlinear pulse automatic control systems consisting in replacement of the initial automatic control system by a statistically equivalent system and optimization of this system. The statistically equivalent system has optimal control coordinates which are identical with those of the initial system and permits a simpler optimization procedure. Author

N68-10319 Joint Publications Research Service, Washington, D. C.

A FORM OF STABILITY OF NONLINEAR PULSE SYSTEMS

Yu. N. Chekhovoy *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 205–216 refs (See N68-10301 01-10)

A special form of stability is investigated (ultimate boundedness) for nonlinear pulse systems with arbitrary, unique nonlinearities and an arbitrary modulation law (pulse-amplitude modulation, pulse width modulation or pulse frequency modulation). The concept of an asymptotically stable set S is introduced for a nonlinear pulse system having the property that all the trajectories of the system (independently of the initial conditions) approach S during the course of time in an unlimited fashion or enter it and never leave it again. A procedure is proposed for evaluation of the bounds of the asymptotically stable set S. Its application is illustrated in the example of investigating an ultimately bounded pulse-frequency system of the second order. Author

N68-10320 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF CORRECTION SYSTEMS WITH FINITE MEMORY

S. G. Duvanov and L. N. Lipatov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 217–231 refs (See N68-10301 01-10)

A procedure has been developed for calculation of the weight functions of correction systems with finite memory under the assumption that the disturbance and control effects in an automatic control system are analytical random processes. It has been shown that for a two-channel control system this method of calculation may be used also in the more general case, that is, without restriction to analyticity of the random processes. Author

N68-10321 Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF STATISTICAL INVESTIGATION OF A SELF-ADJUSTING SYSTEM WITH A STANDARD MODEL

Ye. A. Sankovskiy and V. V. Kruglikov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 232–240 refs (See N68-10301 01-10)

An approximate analytical method of investigating a self-adjusting system with a standard model is investigated with random effects present at the system input. The proposed method is based on the use of the filtering properties of an automatic control system with respect to wideband signals. It permits determination of the fluctuation error in the investigated systems, using linear theory. Author

N68-10322 Joint Publications Research Service, Washington, D. C.

AN EXTREMAL SELF-ADJUSTING SYSTEM BASED ON MEASUREMENT OF THE PHASE SHIFT

K. I. Baykin *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 241–249 refs (See N68-10301 01-10)

An effort is made to generalize the self-adjusting principle based on measuring the phase shift to systems of higher order than the second. The schematic diagram of the extremal self-adjusting system is proposed, and results are presented from experimental testing of it. Author

N68-10323 Joint Publications Research Service, Washington, D. C.

THE QUASISTATIC CONDITION OF THE PARAMETRIC CURVE OF A SELF-ADJUSTING SYSTEM WITH A SPECTRAL ANALYZER

I. N. Pechorina and Yu. A. Baryshnikov *In its* Cybernetics, No. 4 6 Nov. 1967 p 250–260 refs (See N68-10301 01-10)

A procedure is proposed for investigation of one type of self-adjusting system based on the use of quasi-static characteristics. The procedure for calculating the characteristics using integral quadratic estimates is also given. In the specific example the application of the proposed procedure and the calculated expressions obtained to evaluate the efficiency of the spectral method of self-adjustment is demonstrated. Author

N68-10324 Joint Publications Research Service, Washington, D. C.

IMPROVEMENT OF THE QUALITY OF DIGITAL SMOOTHING DEVICES WITH A HIGH ORDER OF ASTATISM

Yu. M. Korshunov, A. I. Bobikov, and V. N. Stepanenko *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 261–268 refs (See N68-10301 01-10)

A smoothing algorithm for discrete random signals is investigated which permits significant increase in the efficiency of noise suppression compared to known procedures. A method is proposed for improvement of the quality of the smoothing circuits by introducing fixed delay in the transmission of the smoothed value of the input signal. Author

N68-10325 Joint Publications Research Service, Washington, D. C.

DYNAMIC PROPERTIES AND CHARACTERISTICS OF NONSTATIONARY LINEAR SYSTEMS OF THE SECOND ORDER

V. P. Bulekov and F. A. Mikhaylov *In its* Cybernetics, No. 4 6 Nov. 1967 p 269–281 refs (See N68-10301 01-10)

Approximate formulas are derived for the solution of a linear differential equation of the second order with variable coefficients. The formulas obtained are used to find the pulse transfer function. Some other characteristics of nonstationary systems are analyzed. Author

N68-10326 Joint Publications Research Service, Washington, D. C.

SEARCH TIME OF A PERIODIC PULSE SEQUENCE IN A PULSE FLUX USING TRIGGERS

V. V. Vasil'yev *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 282–290 ref (See N68-10301 01-10)

The search process is analyzed using a pulse sequence trigger with a known pulse repetition rate in a pulse flux which is constituted of a mixture of periodic pulse sequences the pulse repetition rates of which (excluding the desired one) may assume any values with equiprobability in a frequency interval. The beginning of occurrence of the pulses of each of the sequences is assumed equiprobable during the repetition period of this sequence. The basic special features of the search are investigated, and expressions are obtained which determine the time required to isolate the desired sequence with a probability given in advance. Author

N68-10327 Joint Publications Research Service, Washington, D. C.

COMMENTS ON THE ARTICLE BY N. N. KOROBOV ENTITLED EVALUATING THE EFFICIENCY OF AUTOMATIC CONTROL SYSTEMS WHICH ARE SELF-ADJUSTING WITH RESPECT TO THE INPUT SIGNAL

Yu. A. Gopp and N. N. Korobov *In its* Tech. Cybernetics, No. 4 6 Nov. 1967 p 291–301 refs (See N68-10301 01-10)

A criticism by Yu. Gopp of work by N. N. Korobov which indicates that high efficiency of a self-adjusting automatic control system is achieved by biased selection of the initial data and unsuccessful selection of the efficiency index, is presented. In addition, errors of a mathematical nature which lead to an improbable result, are shown. These errors involve the overestimation of the efficiency of self-adjustment, the unsuccessful selection of the efficiency function, the contradiction arising with correct calculation of the integral, and the lack of correspondence in several formulas. A response to the remarks of Yu. Gopp by Korobov is also presented. L.S.

N68-10365# Los Alamos Scientific Lab., N. Mex.

NET-2 EXTENSIONS AND DIFFERENCES WITH NET-1

Allan F. Malmberg [1967] 10 p ref Presented at the SHARE Design Automation Conf., Los Angeles

(Contract W-7405-ENG-36)

(LA-DC-8787; CONF-670630-1) CFSTI: HC$3.00/MF$0.65

The general features of the NET-2 program are presented. This program under development on the MANIAC computer, will perform nonlinear DC and transient analysis and linearized AC analysis of arbitrary circuit configurations. The language for describing the circuit schematic is presented. Features for inclusion of models of various linear and nonlinear devices are discussed. The program is written so as to permit device models to be added without rewriting NET-2 itself. Models and their parameter values are stored in a model library and called into the calculation automatically. Input facilities are included for superseding library values of device parameters. A major feature of NET-2 is its variational capability. Three types of variational procedures are available: the STATE calculation which varies circuit parameters in discrete steps, the Monte Carlo calculation which determines the statistical distribution of response variables for a given circuit parameter population distribution, and the Extrema Search which extremizes the value of a response variable within an allowable circuit parameter space. Author (NSA)

N68-10415 Technische Hogeschool, Eindhoven (Netherlands).

STEADY STATE AND TRANSIENT PROPERTIES OF ELECTRIC ARCS

Herbert Maximilian and Josef Pflanz (Ph.D. Thesis) 17 Oct. 1967 164 p refs

The pre-interruption arcing period in circuit breakers and the interruption process in general were investigated for electric arcs. Thermodynamic and electrical properties of a gas discharge in thermal equilibrium are studied, with nitrogen as the test gas for comparative purposes. Because the nitrogen arc is similar to an arc in air, the results obtained are considered of possible application to circuit breakers using air as the interrupting medium. Various chapters of this thesis discuss the energy balance equation, models of steady state thermal arc, thermal conductivity and form factors, and response of a two channel arc model to current step modulation. Properties of the arc atmosphere are discussed, as are electrical circuits for arc modulation and measurement on a steady state arc, properties of the arc chamber, and measurements on the cascade arc in nitrogen. M.W.R.

N68-10721# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

COMPUTER AIDED ANALYSIS AND SYNTHESIS OF MULTIVALUED MEMORYLESS NETWORKS

Leon O. Chua and William H. Stellhorn Jun. 1967 137 p refs

(Contract N00016-66-C0076; Grant NSF GR-01235)

(TR-EE67-8; AD-659541)

The report presents a simple but general method--the Iterative Piecewise Linear Method--suitable for the analysis and synthesis of multivalued memoryless nonlinear networks that may contain multivalued nonlinear resistors, controlled sources, ideal transformers, gyrators, negative impedance converters, etc. The method itself is an algorithm, and therefore it can be easily programmed in a computer. Part (1), Analysis of Multivalued Memoryless Networks, considers the operating point problem and the determination of driving-point and transfer Characteristic Plots. Part (2), Piecewise Linear Synthesis of DC Memoryless Nonlinear Networks, describes a simple procedure to synthesize a nonlinear lattice network having prescribed driving-point and transfer plots as well as nonlinear load characteristics. Part (3), Computer Implementation of Analysis and Synthesis Algorithms, describes in detail a series of Fortran Language computer programs for performing the operations described in Parts (1) and (2). Author (TAB)

N68-10723# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASSIGNMENT AND PROGRAM CONTROL OF BOUNDARY CONDITIONS DURING SOLUTION OF NONSTATIONARY BOUNDARY VALUE PROBLEMS ON NETWORK SIMULATORS [ZADANIYE I PROGRAMMNOYE UPRAVLENIYE GRANICHNYMI USLOVIYAMI PRI RESHENII NESTATSIONARNYKH KRAYEVYKH ZADACH NA SETOCHNYKH MODELYAKH]
A. V. Muromskiy 18 Aug. 1967 17 p Transl. into ENGLISH from Analogovyye Metody i Sredstva Resheniya Krayevykh Zadach (Kiev), 1964 p 74–84
(FTD-MT-67-34; AD-659314)

This work considers the system for assigning the boundary conditions in contemporary electronic models, the need for program assignment of boundary conditions for any moments of time, simultaneous assignment of time variables of boundary conditions, stored control of channels for assigning the boundary conditions, and the conversion of the unique electronic integrator EI-S into the universal network electronic model USM-1. The operating conditions of the EI-S boundary condition assignment system are given, as is the functional diagram of the system. TAB

N68-10749# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SIXTH SEMIANNUAL RESEARCH SUMMARY, JANUARY–JUNE, 1967
Jun. 1967 153 p refs
(Contract N00014-67-A0226-0004)
(AD-659540)

Contents: Medical and life sciences; Control and information systems; Electric power systems and energy conversion; Electromagnetic fields; Communication sciences; Nonlinear circuits and systems; Materials; Data processing systems. TAB

N68-10764 Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Elektronik-Institut.
BASIS OF A FAST ANALOG DIGITAL CONVERTER WITH HIGH RESOLUTION [PRINZIP EINES SCHNELLEN ANALOG-DIGITAL-KONVERTERS HOHER AUFLOESUNG]
Rupert Patzelt 1967 16 p In GERMAN; ENGLISH summary Submitted for publication
(SGAE-E-8/1967)

The deadtime of an analog digital converter for electrical pulse spectra can be strongly reduced if the storage capacitor is discharged fast to a value near zero and then slowed down. Simultaneously the oscillator pulses are to be fed to different stages of the address-counter according to the ratio of discharge currents. Switching of the current generators must be synchronized exactly to the oscillator pulses. All the parameters of the conversion can be stabilized as to maintain the high degree of stability and linearity necessary. The design of a converter for 8192 channels with a maximum deadtime of about 25μsec is given. Author

N68-10888# Leeds Univ. (England).
MICROWAVE ALL-PASS NETWORKS
J. O. Scanlan and J. D. Rhodes Griffiss AFB, N. Y. RADC Jul. 1967 69 p refs
(Contract AF 61(052)-925)
(RADC-TR-67-385; AD-659153)

The paper shows that any arbitrary delay characteristic of a commensurate microwave network which supports a T.E.M. mode of propagation, may be realized by means of a transformerless, coupled-line network within an arbitrary additive constant. The realization procedure presented is based upon the synthesis of microwave C-type and D-type all-pass sections. Synthesis procedures are also developed for the direct realization of a complete all-pass network which include interdigital line structures. The application of microwave all-pass networks to the phase correction of conventional microwave filters and to the construction of delay networks with linear delay characteristics is also presented. Author (TAB)

N68-10923# Lincoln Lab., Mass. Inst. of Tech., Lexington.
IDENTIFICATION OF SYSTEMS IN TERMS OF THE WIENER MODEL
Charles R. Arnold 22 Aug. 1967 52 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-480; TN-1967-34; AD-659159)

The report presents briefly a nonlinear model originally proposed by the late Norbert Wiener for the characterization of general systems. Three procedures are then offered for the identification of any given system in terms of the Wiener model. Finally, this report presents the results of a digital computer simulation study (utilizing six somewhat arbitrary systems) which was designed to evaluate the various identification procedures as well as the model itself as a basis for system identification. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-10011# Stanford Univ., Calif. Linear Accelerator Center.
DESIGN, CONSTRUCTION, AND PERFORMANCE OF A 5800 KW (11,000AMP) POWER SUPPLY FOR A SPARK CHAMBER MAGNET
C. A. Harris and Paul Edwards Jul. 1967 10 p Presented at the 2d Intern. Conf. on Magnet Technol., Oxford, 11–14 Jul. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-329; CONF-670705-9) CFSTI: HC $3.00/MF $0.65

A 5,800-kW (525 V at 11,040 A) power supply for energizing a bubble chamber magnet having an 80-inch diameter pole is discussed. Topics include physical construction, control system, ac power system, dc power system, regulation system, radio-frequency interference, and provisions for testing and monitoring. NSA

N68-10018# Ballistic Research Labs., Aberdeen Proving Ground, Md.
HARP 5-INCH AND 16-INCH GUNS AT YUMA PROVING GROUND, ARIZONA
Charles H. Murphy and G. V. Bull (McGill Univ.) Feb. 1967 50 p refs
(BRL-MR-1825; AD-654123)

The 5- and 16-inch guns at Yuma Proving Ground and their associated instrumentation and flight results for 1966 are described in detail. The introduction of multi-point ignition for the 16-inch gun produced a record altitude of 111 miles using special propellants and the moderate altitude of 77 miles with surplus naval propellant. Twenty-four ionospheric wind profiles have been obtained from 16-inch gun firings and 15 stratospheric profiles from the 5-inch firings. Telemetry performance and ground recovery capability have been demonstrated. Author (TAB)

N68-10102*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROCEDURE FOR PERSONNEL CLEAN ROOM DEPORTMENT
F. N. Le Doux May 1966 12 p
(NASA-TM-X-55998; X-723-66-240) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The AIMP spacecraft mission in the near vicinity of the moon makes it mandatory that any particulate matter capable of sustaining microbial life forms are held to a bare minimum. Therefore, it is required that field operations such as experiment checkouts and/or work conducted on a component part of the spacecraft system be carried out in a clean room environment. During any operation in a clean room environment where a component is handled or a test is being performed on the spacecraft, it is highly probable that particulate and/or microbiological contamination from personnel and/or the tools used in conducting tests will be released and transferred. In order to minimize the release and/or transfer of this contamination, it is necessary that a set plan or procedure be followed so as to reduce to the lowest level possible the biological and particulate population. Procedures are written with this aim in mind. Author

N68-10334 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
EXPERIMENTAL FACILITIES AT V.K.I. [INSTALLATIONS EXPERIMENTALES DE L' I.V.K.]
1967 80 p refs In ENGLISH and FRENCH Ed. 2

Descriptions of present and planned test facilities at the Von Karman Institute are given along with related photographs and schematic diagrams. Present facilities include three low speed, four supersonic and two hypersonic wind tunnels, and a large turbomachinery laboratory with two cascade tunnels and four rotor test stands. E.C.

N68-10347# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
WEATHER EFFECTS ON VORTAC FACILITIES TACAN MONITOR ANTENNA TESTS Final Report
Jack A. Muller Aug. 1967 25 p
(FAA-RD-67-6)

The most practical and effective heating method was determined from several prototype units that were developed to clear snow and ice deposits from TACAN monitor antenna faceplates; these snow and ice deposits may result in unnecessary TACAN outages. The prototype unit considered most effective was installed for operational winter evaluation at various selected problem field sites. Author

N68-10384* Sandia Corp., Albuquerque, N. Mex.
CONTAMINATION CONTROL PRINCIPLES
Washington NASA 1967 51 p refs
(Contract NASw-12324)
(NASA-SP-5045) CFSTI: $3.00 CSCL 14B

A basic contamination control model is outlined to define the overall field in terms of contaminants and environments which they affect. Contamination control considerations and principles in product design are discussed followed by detailed descriptions of clean rooms, clean work stations, and other work enclosures used to control airborne contaminants. The discussion also covers processes and methods used in cleaning product surface; contamination in liquids, gases, and solids; the effects and means of controlling radiation and microbial contamination; methods of detecting the various types of contaminants; controlling contamination in packaging, transport, and storage; and personnel control and management at contamination control facilities. R.N.A.

N68-10432# California Univ., Berkeley. Lawrence Radiation Lab.
COST OPTIMIZATION OF STORAGE RING MAGNET SYSTEMS
Michael A. Green 14 Jun. 1967 14 p refs Presented at the 2nd Intern. Conf. on Magnet Technol., Oxford, 11–14 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-17354; CONF-670705-12) CFSTI: HC $3.00/MF $0.65

A magnet cost optimization analysis is made of storage ring magnet systems. Three systems studied are the CERN intersecting storage ring, the Omnitron storage ring, and a hypothetical dc storage ring of the same size, shape, and field as the June 1965 version of the Injector Synchrotron for the 200-BeV Design Study. NSA

N68-10570# Communication Systems, Inc., Paramus, N. J.
A STUDY LEADING TO THE CONSTRUCTION OF A TROPOSCATTER SIMULATOR Final Report, 1 Jul. 1966–30 Jun. 1967
Melvin S. Klein and Jack B. Harvey Sep. 1967 44 p refs
(Contract DA-28-043-AMC-02545(E))
(CSI-67-TR-2437; ECOM-02545-F; AD-659914)

The objective of this program was to study the requirements for and develop a new troposcatter simulator which reproduces the dynamic fading and multipath variations observed on tactical tropo hops of 50 to 200 miles using antenna beamwidths of 0.5 to 2.0 degrees, in a 10 MHz rf bandwidth centered on the 70 MHz input/output frequency. A novel approach was used to overcome the limitations common to previous designs for simulation of dispersive media, an 81 path matrix provides continuously variable delay and attenuation under the real time control of a small stored-program digital computer (DEC Model PDP-8) to reproduce the fine grain multipath and fading characteristics of the medium in accordance with a pseudo-random sequence which is precisely repeatable at the operator's discretion. The result of this effort was a laboratory model which met all of the technical requirements including simulation of dual diversity, operator control of fad rate, median level, delay spread, aircraft doppler plus the ability to playback any desired portion of the simulated test run. There are no restrictions on the type of modulation (digital or analog) which may be tested since no fixed delays are used, the entire simulator is housed in a standard six-foot cabinet except for the external ASR-33 teletypewriter/printer which controls the PDP-8 Computer. There are no controls, all operator functions being in the form of computer instructions. Author

N68-10594*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
A COMPARATIVE STUDY OF PUMPING SYSTEMS FOR A CHEMICAL PROPULSION ALTITUDE TEST STAND
Albert A. Yetman Dec. 1966 40 p refs
(NASA-TM-X-63001; X-734-66-591; TM-66-01) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This report describes the results of a feasibility study conducted to determine the size, type and comparative cost of an altitude facility for testing small chemical rocket engine components and systems. The study was intended to determine gross overall requirements and to select a suitable conceptual plan for a detailed design. The major design requirement for the facility would be to maintain a 200,000 foot altitude condition while pumping exhaust products, having a molecular weight of 22.0 and a temperature of 5000°F, at a rate of 0.08 lbs. per second. Three methods of achieving the above conditions were considered: a mechanical pump system, a boiler steam ejector system, and a Hyprox steam generator ejector system. A discussion of the economic feasibility of using rental facilities is included. Author

N68-10617# Arecibo Ionospheric Observatory, Puerto Rico.
ARECIBO IONOSPHERIC OBSERVATORY
Jul. 1967 20 p
(Contract F44620-67-C-0066)
(AFOSR-67-2037; AD-659440)

The brochure describes the Arecibo Ionospheric Observatory and the scientific research program being carried there with the worlds largest radio-radar telescope. Arecibo is operated by Cornell University with funding provided by the Advanced Research Projects Agency of the Department of Defense under a research contract with the Air Force Office of Scientific Research, Office of Aerospace Research, USAF. The brochure provides general and technical information on the facility, its capabilities and uses, and on radio-radar astronomy techniques and history. Technical data on the facility enables potential users of the facility to assess its applicabilities to their projects. Author (TAB)

N68-10638# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THE ISENTROPIC COMPRESSION TUBE: A NEW APPROACH TO GENERATING HYPERVELOCITY TEST FLOWS WITH LOW DISSOCIATION
F. J. Stoddard, A. Hertzberg, and J. Gordon Hall Wright-Patterson AFB, Ohio ARL Jun. 1967 35 p refs
(Contracts AF 33(615)-5389; AF 33(657)-8860)
(CAL-AD-1716-A-17; ARL-67-0133; AD-659154)

A new approach to generating high-velocity air flows with very low ambient dissociation levels is discussed. Briefly, the approach utilizes a nonsteady isentropic compression wave which is focused through an area contraction to accelerate and compress the test gas. This processed gas may be used directly as a test medium or may be allowed to expand non-steadily through the expansion wave which appears at the focal point of the compression wave system. In either case, the flow may be further expanded in a nozzle if so desired. The advantages and disadvantages of both methods of operation are discussed. The problem of generating the required wave motion is presented in some detail and preliminary studies of several possible driving techniques are summarized. Author (TAB)

N68-10856 Joint Publications Research Service, Washington, D. C.
AIRBORNE AUTOMATIC SEEDING APPARATUS (SADU-1)
A. D. Volkov 21 Nov. 1967 6 p Transl. into ENGLISH from Tr. Ukr. Nauchno- Issled. Gidrometgordl. Inst. (Leningrad), no. 61, 1966 p 118–122
(JPRS-43400) CFSTI: $3.00

Details are presented on the design and construction of the apparatus for seeding supersaturated stratus clouds and mists during winter. Granulated CO_2 is discharged at the rate of 0.8–10.0 kg/min. The apparatus is operated from the aircraft's auxiliary system, and requires 3000 watts at a potential of 27.5 volts. The bunker, seeding wheel and mechanism, electric motor, and hoist are described, along with the electric circuit. Schematics of the seeding apparatus and the electric circuit are included. N.E.N.

N68-10925# Stanford Univ., Calif. Linear Accelerator Center.
STREAMER CHAMBER DEVELOPMENT
F. Bulos, A. Odian, F. Villa, and D. Yount Jun. 1967 142 p ref
(Contract AT(04-3)-515)
(SLAC-74) CFSTI: HC $3.00/MF $0.65

Comparisons are made between wide-gap spark chambers and wide-gap streamer chambers before a detailed account of streamer chamber technology is presented. Descriptions are given of properties and experimental observations relating to streamers, optics, and chamber and high voltage technology. A brief comparison of data analysis problems for streamer and bubble chambers is made. Design, development, and testing of a two-meter streamer chamber (during the preliminary stages of the photoproduction program) are also described. E.C.

N68-10938# Cambridge Electron Accelerator, Mass.
CAMBRIDGE ELECTRON ACCELERATOR Semiannual Report, Jul. 1–Dec. 31, 1966
14 Jul. 1967 31 p ref Sponsored by MIT and Harvard Univ.
(Contract AT(30-1)-2076)
(CEAL-1036) CFSTI: HC $3.00/MF $0.65

Part I indicates the purpose of the work, which is concerned with the operation of the 6-GeV Cambridge Electron Accelerator. Part II states the general nature of each of the 38 experiments that were in progress or in preparation during the six-month period in question. Part III lists the principal improvements made in the accelerator and the associated facilities. Part IV deals with the routine operation of the accelerator, and indicates that the half-year in question was far more productive, in terms of user-hours, than any previous half-year period. Part V deals with safety, and indicates that there were no lost-time accidents. Part VI summarizes the plan for using the present ring as a beam storage and colliding beam facility; also it describes new tests and demonstrations of beam storage, including the storing of 3 GeV electrons for 20 minutes, a new world's record. This project continues to appear highly promising. Part VII deals with preparations for the sixth International Conference on High Energy Accelerators, to be held in Cambridge on September 11–15, 1967. Author (NSA)

N68-10961# Bureau of Mines, Pittsburgh, Pa.
FIRE HAZARD OF CONVEYOR BELTS
Donald W. Mitchell, Edwin M. Murphy, Allan F. Smith, and Samuel P. Polack Dec. 1967 19 p refs
(BM-RI-7053)

The fire hazard of neoprene, polyvinyl chloride, and rubber conveyor belts was studied at the Federal Bureau of Mines Experimental Coal Mine. The effects of intensity of ignition source, velocity of the ventilating air, and type of belt were investigated at three levels in small-scale gallery experiments. Studies were made in the mine on the effects on ignition and flame propagation of belt-entry dimensions, belt widths, and belt configuration. Methods for extinguishing belt fires were also investigated under simulated mining conditions, and during these trials coal dust and grease were placed on the belt. The research showed that conveyor belts will burn. Neoprene, polyvinyl chloride, and rubber belts, with and without carcass, ignited and propagated flame. The highest rate of flame propagation was obtained on rubber belt. The fire hazard increased with increase in intensity of ignition source and air velocity. Author

N68-10975*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SYSTEMS SAFETY CRITERIA FOR USE IN PREPARATION OR REVIEW OF PROCEDURES
Preston T. Farish 17 Oct. 1967 27 p
(NASA-TM-X-53664) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Suggested checklists for insuring systems safety features for the preparation or review of procedures are given for various areas of launch, operating, test, checkout, maintenance, handling, calibration, and ordnance procedures for space vehicles. Author

N68-10990 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
TECHNICAL CHARACTERISTICS AND OPERATIONAL PROCEDURE OF CNEN'S INDIVIDUAL DOSIMETRY FACILITY [CARATTERISTICHE TECNICHE E MODALITA OPERATIVE DEL SERVIZIO DI DOSIMETRIA INDIVIDUALE DEL CNEN]
G. Busuoli and A. Cavallini 1967 22 p In ITALIAN
(RT/PROT(67)12)

Organization of the individual dosimetry facility at the national nuclear energy installation in Rome is detailed, along with the characteristics of the dosimetry equipment. Unit costs for individual readings are included. Transl. by M.W.R.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-10025# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF THE LIMITED LAYER OF THREE-DIMENSIONAL LAMINAR COMPRESSIBLE FLOW WITH HEAT TRANSFER [CONTRIBUTION A L'ETUDE DE LA COUCHE LIMITE TRIDIMENSIONNELLE LAMINAIRE, COMPRESSIBLE AVEC TRANSFERT DE CHALEUR]
Li Fang Tsen Serv. de Doc. Sci. et Tech. de l'Armement, 1967 124 p refs In FRENCH *Its* No. 435

The nature of viscosity was studied on compressible flow against an optional obstruction for an arbitrary temperature range at the threshold. The solutions were related to a linear equation for transverse flow. The integral calculation was confined to the three dimensional laminar layer. Transl. by T.Z.D.

N68-10042* Scientific Translation Service, La Canada, Calif.
TURBULENT BOUNDARY LAYER ON A CATALYTIC SURFACE IN A NONEQUILIBRIUM DISSOCIATING GAS [TURBULENTNYY POGRANICHNYY SLOYNA KATALITICHESKOY POVERKHNOSTI V NERAVNOVESNO DISSOTSIIRUYUSHCHEM GAZE]
Yu. V. Lapin Washington NASA Nov. 1967 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), no. 3, 1967 p 70–76
(Contract NASw-1496)
(NASA-TT-F-11375) CSCL 20D

Development of a successive-approximation technique which makes it possible to calculate a turbulent boundary layer on a plane catalytic plate in a nonequilibrium dissociating gas for any dissociation rate. The assumptions used in the derivation are those conventionally employed in turbulent boundary layer theory. The excellent convergence of the method is due to the fact that allowance for the nonequilibrium effects of the dissociation process on the distribution of the boundary layer parameters, and hence on friction and heat transfer, can be reduced to the determination of corrections to the distribution of the parameters in equilibrium or frozen flows. Author

N68-10107# Advisory Group for Aerospace Research and Development, Paris (France).
RECENT ADVANCES IN AEROTHERMOCHEMISTRY. VOLUME 2
I. Glassman (Princeton Univ.), ed. 1967 410 p refs Papers presented at the 7th AGARD Colloq., Oslo, 16–20 May 1966
(AGARD-CP-12, V. 2)

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5. MASS SPECTROMETIC STUDIES OF IMPURITY IONIZATION IN SHOCK-HEATED ARGON B. Sturtevant and C. P. Wang (Calif. Inst. of Tech.) p 593–606 refs (See N68-10112 01-33)

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10. MEASUREMENTS OF RELAXATION EFFECTS IN NOZZLE FLOW OF HOT COMBUSTION GASES BY MEANS OF A SHOCK TUBE TECHNIQUE II Th. Just and H. Pippert (Deutsche Versuchsanstalt für Luft- und Raumfahrt) p 761–776 refs (See N68-10117 01-33)

11. UNSTEADY, DIFFUSING, REACTING, TUBULAR FLOW WITH APPLICATION TO THE FLOW IN A GLOW DISCHARGE TUBE G. Emanuel (Aerospace Corp.) p 777–797 refs (See N68-10118 01-12)

12. EXPERIMENTAL AND ANALYTICAL CONSIDERATION OF TURBULENT HETEROGENEOUS MIXING IN THE WAKE V. Zakkay and H. Fox (N. Y. Univ.) p 799–844 refs (See N68-10119 01-12)

N68-10108# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
RECENT STUDIES OF NONEQUILIBRIUM FLOWS AT THE CORNELL AERONAUTICAL LABORATORY
J. Gordon Hall and Anthony L. Russo *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 443–475 refs (See N68-10107 01-12)
(Contracts NASr-109; AF 49(638)-792; AF 33(657)-8860)

Three studies are described which typify areas of research on non-equilibrium flows. The first study dealt with vibrational relaxation in supersonic nozzle flows where line-reversal temperature measurements for N_2 nozzle expansions show unexpectedly fast vibrational deactivation. The second study was on nonequilibrium airflow over a flat plate having a large-angle-wedge leading edge. In the flow regime of interest, appreciable excitation of vibration and dissociation occurred before flow expansion around the wedge-plate corner and viscous effects were large in the expanded

flow. The third study is on the calculation of nonequilibrium flow fields about blunt bodies at arbitrary angle of attack. A direct numerical method for this problem was successfully developed in which the nonsteady terms are retained in the basic equations. The earth-reentry flow field of an Apollo type vehicle at 20° angle of attack is described, with emphasis on electron density distribution and its implication for communication blackout. Author

N68-10109# Technische Hochschule Darmstadt (West Germany). Institut fuer Mechanik.

STEADY ONE-DIMENSIONAL FLOW OF A GAS WITH RELAXATION

Ernst Becker *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 477–506 refs (See N68-10107 01-12)

The properties of a one-dimensional steady flow of gas, with several thermodynamical relaxation processes taking place in the gas, are discussed insofar as these properties may be inferred directly from the basic equations governing the mechanical and thermodynamical behavior of the gas. The assumptions about the thermodynamical behavior of the gas are rather general and encompass a wide class of relaxation phenomena, including relaxation of internal degrees of freedom, and dissociation or chemical reactions with finite reaction rates. The existence of fully dispersed waves and partly dispersed waves, or shocks with continuous relaxation zones, is shown; and the dependency of velocity, density, pressure, and the relaxation parameters on the space variable was studied in detail for the case of two relaxation parameters. The case that only one relaxation parameter is of importance may be easily deduced in several ways from the case of two relaxation processes. Author

N68-10110# Royal Aircraft Establishment, Farnborough (England).

SPECTRUM-LINE-REVERSAL TEMPERATURE MEASUREMENTS THROUGH UNSTEADY RAREFACTION WAVES IN VIBRATIONALLY RELAXING GASES

T. A. Holbeche and J. G. Woodley *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 507–567 refs (See N68-10107 01-12)

Pressure and spectrum-line-reversal (SLR) temperature measurements were made of the structure of an unsteady expansion wave initiated in vibrationally-excited but undissociated gases in a shock tube by the rupture of a second diaphragm. With expanding nitrogen initially at about 2800°K and 8 atm pressure, vibrational de-excitation rate inferred from the temperature measurements was at least an order of magnitude faster than that based on shock-wave excitation data and on a linear rate law. With oxygen, de-excitation was apparently almost an order of magnitude slower than that expected from the shock-wave relaxation data. With carbon monoxide as the test gas, the inferred rate of vibrational de-excitation was not significantly different from the shock-wave derived data. Small departures of the flow pattern from the simple one-dimensional inviscid model do not appear to arise from the vibrational relaxation. The desirability of checking the SLR technique by a method based on the infrared emission of CO or NO added to the flow is discussed. Author

N68-10111# Ballistic Research Labs., Aberdeen Proving Ground, Md. Exterior Ballistics Lab.

INTERFEROMETRIC MEASUREMENT OF NONEQUILIBRIUM FLOW FIELDS AROUND CONES AND COMPARISON WITH CHARACTERISTIC CALCULATIONS

J. H. Spurk, D. T. Knauss, and J. M. Bartos *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 569–592 refs (See N68-10107 01-12)

Experimental investigations of the nonequilibrium flow fields around cones were compared with theoretical predictions. The experiments were conducted in an expansion tube, where an unsteady expansion process was used to generate the high enthalpy, high Mach number test flow at low free stream dissociation level. Shock shape and density distribution in the shock layer are discussed. Tests were made using oxygen as test gas at approximately 10,000 ft/sec and using air as test gas at approximately 20,000 ft/sec. The inviscid supersonic flow fields were calculated using the method of characteristics. The gas model adopted for oxygen was a mixture of the neutral species N_2, O_2, NO, O. Vibrational equilibrium was assumed throughout the relaxation layer. Author

N68-10113# Yale Univ., New Haven, Conn.

NON-EQUILIBRIUM NOZZLE FLOW WITH CONDENSATION

Peter P. Wegener and Jean-Yves Parlange *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 607–634 refs (See N68-10107 01-12)

Condensation of vapor and vapor-gas mixtures in supersonic nozzle flows is discussed. The limiting conditions of equilibrium and frozen flow, and the thermodynamics of the collapse of the supersaturated flow are demonstrated. New results are presented on the nature of the condensate produced by homogeneous nucleation of water vapor in inert air. It is deduced from experiments that the condensate is finely dispersed after equilibrium is attained. Study of these extremely small clusters may shed new light on nucleation theory, surface free energy and other aspects of phase transition at low temperature. Author

N68-10114# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

DISCUSSION OF THE STABILITY OF INTERMEDIATE SOLUTIONS IN THE ANALYSIS OF RELAXED FLOWS [DISCUSSION DE LA STABILITE DES SOLUTIONS INTERVENANT DANS L'ANALYSE DES ECOULEMENTS RELAXES]

Roger Prud'homme *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 635–682 refs In FRENCH (See N68-10107 01-12)

Stability of intermediate solutions in relaxed gas flows is investigated, and equations that record the flow and the chemical reactions are presented. Wind tunnel studies of relaxed flow deal with isentropic processes and equilibrium molecular relaxation, and thermodynamic equilibrium; and various stability problems are considered. Theories for treating stability are discussed, and stability solutions in near equilibrium are considered. Small perturbations equations with constant and variable coefficients are discussed in light of the stability of solutions of multireactive gas flows; and linear theory is then applied to the stability of solutions, with near equilibrium and the singular point zone treated. Transl. by M.W.R.

N68-10115# Bristol Siddeley Engines, Ltd. (England).

COMPARATIVE EVALUATION OF SEVERAL APPROXIMATE METHODS OF ANALYSIS OF NON-EQUILIBRIUM NOZZLE FLOWS

R. W. McIntyre and R. S. E. Leslie *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 583–699 refs (See N68-10107 01-12)

In using one-dimensional models to analyze nonequilibrium nozzle flows, a numerical condition called stiffness arises because of the tremendous number of steps required to integrate the chemical rate equations. To illustrate these numerical difficulties, the flow representing kerosene/air combustion products undergoing supersonic expansion was studied. An exact solution for the five reactions of an example required nearly 17,000 steps, whereas the shifting equilibrium limit could be obtained in only 176 steps by an approximate method. Partial equilibrium and sudden freezing approximation methods are discussed; and both of these methods treat reactions individually and use an inspection process to replace equilibrium constraints in the case of either frozen or kinetic

equations. The sudden freezing method can be interpreted algebraically and requires only 10 or 20 steps to compute a nozzle flow. M.W.R.

N68-10118# Aerospace Corp., El Segundo, Calif.
UNSTEADY, DIFFUSING, REACTING, TUBULAR FLOW WITH APPLICATION TO THE FLOW IN A GLOW DISCHARGE TUBE
George Emanuel *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 777–797 refs (See N68-10107 01-12)

A theory is given for the concentration profile of a diffusing, reacting, and partially dissociated gas as it convects down a glow discharge tube. The atom concentration profile is a step function, and incompressible two-dimensional or axisymmetric Poiseuille flow is required. With increasing time, the concentration changes in a layer that convects down the tube, and the width of the layer increases. Measurement of the concentration profile at various positions along the tube is used to deduce the atom-molecule diffusion coefficient. An approximate analytic solution for the atom concentration in the layer is found by introducing a small parameter which is the ratio of tube radius to layer width. A first- and second-order solution, which accounts for axial diffusion and dispersion as well as gas-phase and wall recombination, results in a quadratic equation that relates to dimensionless parameters. One of these contains the desired diffusion coefficient, which has one value corresponding to axial diffusion dominating dispersion and the other value to the reverse situation. A method is given for resolving the nonuniqueness. Author

N68-10119# New York Univ., N. Y.
EXPERIMENTAL AND ANALYTICAL CONSIDERATION OF TURBULENT HETEROGENEOUS MIXING IN THE WAKE
Victor Zakkay and Herbert Fox *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 799–844 refs (See N68-10107 01-12)

The turbulent mixing of two streams is discussed, and the profiles and decay downstream of coaxial mixing are shown to behave in an analogous form to the near and far wake problem. Injection at the base of the model was performed at $M_\infty = 4$ to investigate the transitional phenomena which occur between the base problem and the problem of coaxial mixing. It is demonstrated that the separated region in the base may be eliminated with 2% injection of air in the base, or with 1/2% of hydrogen. An increase of base pressure of the order of two is associated with these injection rates. The theoretical analysis was conducted by obtaining the solution of the boundary-layer equations by a finite difference scheme which permitted various initial conditions and assumptions for transport properties. When properties obtained from the computer are compared to experimental profiles the eddy viscosity which best correlates the experimental mixing results is based on the product of the wake half radius and the mass flow at the centerline. Author

N68-10132 Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
FLUCTUATING TURBULENT STRESSES IN THE NOISE-PRODUCING REGION OF A JET
Ian S. F. Jones Sep. 1967 49 p refs
(RR-7)

Data about the fluctuating turbulent stresses and the pressure fluctuations over the first 8 diameters of a low speed jet have been collected. The intensity of the stress, its fixed frame spectrum and the filtered correlation coefficients have been measured on three different nozzles. Some supporting measurements of the more conventional velocity fluctuations have been included. Author

N68-10143 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
A FORTRAN IV COMPUTER PROGRAMME FOR THE SOLUTION OF THE STEADY-STATE, TWO-DIMENSIONAL EQUATIONS OF MOTION, ENERGY AND CONCENTRATION
A. K. Runchal and M. Wolfshtein Aug. 1967 47 p refs
(SF/TN/10)

This paper is designed to satisfy the need for a comprehensive description of the computer program developed for the solution of equations of motion. The paper is concerned with the steady-state, two-dimensional momentum and conserved property equations in a variable-viscosity but constant-density flow; it gives details of the most recent version of this program as well as hints on its use, and some background information. Author

N68-10158# Aerospace Corp., El Segundo, Calif.
RESTRICTED VARIATIONAL PRINCIPLE METHOD FOR THE FREE MOLECULAR MIXING OF PARALLEL STREAMS
C. R. Ortloff Jun. 1967 20 p refs
(Contract AF 04(695)-1001)
(TR-1001(2240-20)-17; SSD-TR-67-97; AD-656337)

Rosens restricted variational principle representation of the Boltzmann equation is used to determine the free molecular mixing of two initially parallel gas streams of differing temperature and speed ratio. Mixing is accomplished by means of thermal and convective motions of the gas particles. It is shown that the variational method leads to a rapid calculation scheme for number density and velocity; results of the method compare closely to exact special function solutions of the collisionless Boltzmann equation. Author (TAB)

N68-10175# France. Ministere de l'Air, Paris.
REVOLVING JETS IN CONFINED SPACE [JETS TOURNANTS EN ESPACE CONFINE]
Bohdan Utrysko Serv. de Doc. Sci. et Tech. de l'Armement, 1967 98 p refs In FRENCH *Its* No. 436

A turbulent mixture consisting of an incompressible jet fluid surrounded by a fluid of the same nature was tested within the circular section of a conduit. The jet was activated by an initial rotation around its axis. A close relationship was established between the profiles of longitudinal and of tangential speed for the revolving intensities studied. An adaptation was made of the Craya–Curtet theory on revolving jets. Transl. by T.Z.D.

N68-10219*# Operations Research, Inc., Santa Monica, Calif.
A METHOD OF CHARACTERISTICS SOLUTION FOR THE EQUATIONS GOVERNING THE UNSTEADY FLOW OF LIQUIDS IN CLOSED SYSTEMS
R. J. Krane and A. Reiff 30 Aug. 1966 126 p refs
(Contract NAS8-5321)
(NASA-CR-89954; TR-388) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This report is a study of the unsteady flow of liquids in closed, unbranched systems. It includes the derivations of the governing equations and their method of characteristics solution for systems containing both distributed and concentrated losses. The resulting computer program and sample outputs from this program are also presented. Author

N68-10330 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
AN IMPROVED METHOD FOR PREDICTING THE EFFECTIVENESS OF THE UNIFORM-DENSITY, TWO-DIMENSIONAL WALL JET
S. C. Kacker, W. B. Nicoll, and J. H. Whitelaw May 1967 35 p refs
(TWF/TN/30)

The procedure for predicting the adiabatic wall effectiveness previously described by Nicoll and Whitelaw has been made more general by the inclusion of a second conserved property equation. The earlier initial condition correlations have been modified to take account of additional experimental data: experiments are described which confirm the validity of this data. Author

N68-10337 Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
STABILITY OF ONE-DIMENSIONAL INCOMPRESSIBLE INVISCID FLOWS
E. Wasserstrom Aug. 1967 36 p refs
(TAE-72)

Experiments were conducted to determine the stability of one-dimensional Cartesian, cylindrical and spherical, incompressible, inviscid flows with no body forces and no interfaces. For Cartesian flows it is found that the necessary and sufficient condition for stability is that the density gradient and the acceleration be in opposite directions. An additional condition is needed for the stability of cylindrical and spherical flows. It was also shown that all expansion flows are unstable. Necessary and sufficient conditions for stability are found. Author

N68-10396# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
CALCULATION OF THE INTERACTION OF AN AXISYMMETRIC SUPERSONIC UNDEREXPANDED JET WITH AN OBSTACLE [RASCHET VZAIMODEISTVIYA OSESIMMETRICHNOI SVERKHZVUKOVOI NEDORASSHIERNNOI STRUI S PREGRADOI]
N. E. Khramov Oct. 1967 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk. Mekhan. Zhidosti i Gaza, SSSR, no. 5, 1966
(TR-43)

With the aid of the method of integral relations and the method of characteristics, a scheme of numerical solution of the interaction of a supersonic underexpanded jet with an obstacle is constructed. The results of calculations are cited. Author

N68-10499*# Massachusetts Inst. of Tech., Cambridge.
A THREE-DIMENSIONAL HARD SPHERES THEORY OF SCATTERING OF GAS ATOMS FROM A SOLID SURFACE
Frank O. Goodman Washington NASA Nov. 1967 95 p refs
(Grant NGR-22-009-121)
(NASA-CR-933) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A three-dimensional model of the interaction of monatomic gases with solid surfaces is described. The solid surface is represented by similar, non-interacting, hard spheres, the centers of which form initially a regular two-dimensional array; an incident gas atom is represented by a hard sphere incident on this array. Collisions between the gas atom and the surface atoms obey the ordinary laws of classical hard spheres. The closely-related problems of the detailed velocity distribution of the gas atoms reflected from the surface, the energy and momentum accommodation coefficients and the forces exerted on a target by a directed gas beam, are discussed and illustrated by means of a fairly comprehensive set of results. Author

N68-10543# ARO, Inc., Arnold Air Force Station, Tenn.
FLOW FIELD OF A SONIC JET EXHAUSTING COUNTER TO A LOW DENSITY SUPERSONIC AIRSTREAM Final Report, 25–26 Apr. 1966
Robert A. Cassanova Arnold Eng. Develop. Center Oct. 1967 31 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-149; AD-659372)

The flow field of a sonic jet exhausting counter to a supersonic airstream was investigated theoretically and experimentally. The total shock-layer thickness was calculated using a blunt-body-type analysis and the known properties of a free-jet expansion from a sonic orifice. The total shock-layer thickness and position of the outer shock relative to the orifice are shown to be a function of free-stream Mach number, jet reservoir pressure, free-stream pitot pressure, and orifice size. The predicted inner shock position is compared with previously published experimental data, and the predicted outer shock position is compared with data obtained in a low density wind tunnel. Results in the transitional flow regime indicate that the outer shock to orifice position distance is greater than the predicted value. Author (TAB)

N68-10547# Stanford Univ., Calif. Dept. of Civil Engineering.
RESPONSE OF GRAVITY WATER WAVES TO WIND EXCITATION
James B. Bole and En Yun Hsu Jun. 1967 171 p refs
(Contract Nonr-225(71); Grant NSF GK-736)
(TR-79; AD-659704)

The primary purpose of this work was to study the response of gravity water waves to wind excitation, and in particular the applicability of the Miles inviscid shear-flow theory of gravity wave growth, by conducting experiments in a laboratory wind-wave channel under conditions approximating the assumptions of the mathematical model. The secondary objective was to document features of the coupled wave-response/wind-excitation system for comparison with the assumptions of Miles theory. Mechanically generated wave profiles were measured with capacitance wire sensors and wave energy was calculated at seven stations spaced at 10-ft intervals along the channel test section. Waves varied in length from about 2.5 to 6.5 ft and maximum wind speeds ranged from 12 to 44 fps. Two sources of evidence indicate that without some modification the Miles inviscid theory may be inapplicable to gravity wave growth on a sufficiently rough water surface. First, the measured growth rates were significantly larger than theory predicts. Second, the superposed ripple standard deviations were larger than the respective critical layer thicknesses. Measured energy growth is not inconsistent with the energy transfer expected from flow separation. Author (TAB)

N68-10566# Colorado State Univ., Fort Collins. Fluid Mechanics Program.
DIFFUSION FROM AN INSTANTANEOUS POINT SOURCE INTO A TURBULENT BOUNDARY LAYER
Suresh Chandra Aug. 1967 157 p refs
(Grant DA-AMC-28-043-65-G20)
(CER67-68SC7; AD-659390) CFSTI: HC $3.00/MF $0.65

Diffusion of helium gas from an instantaneous point source within a neutral boundary layer was studied. Concentrations from a simulated point source, located at a fixed height of eight inches above a smooth surface, were measured for several downstream cross-sections of the diffusing cloud. The free stream velocity for the entire study was 20 ft/sec. Statistical parameters were used to describe the concentration data in terms of the time-average as well as the maximum instantaneous concentration at a point in the diffusion field. The lateral and vertical diffusivities are determined from the diffusion data. Comparison of data from the instantaneous point source, in terms of the time-averaged concentration parameters, with the continuous point source data of other investigators shows good agreement. The concentration data are presented in terms of dimensionless parameters. Separation of the total dispersion into two components, spreading and meandering, is obtained on the basis of Giffords fluctuating plume model. The results of this analysis were used to determine the Hay-Pasquill scale parameter which related the Lagrangian and Eulerian scales of turbulence. Author (TAB)

N68-10611 Lockheed Missiles and Space Co., Palo Alto, Calif.
TURBULENT BOUNDARY LAYER IN THE PRESENCE OF CHEMICAL REACTIONS ON THE SURFACE (APPLIED TO CARBON SURFACES)
E. G. Zaulichnyi, S. S. Kutateladze, and A. N. Leont'ev [1967] 8 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekh. Fiz. (USSR), No. 4, 1967 p 92–96

Formulas are obtained for the limiting heat exchange law when chemical reactions occur on an entrainable surface, as well as within the boundary layer. Formulas are constructed to determine the heat content of walls for the complex heat exchange case taking account of gas injection due to thermal decomposition of the material. Author

N68-10619 Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYSIS OF A BOUNDARY LAYER WITH CHEMICAL REACTIONS ALONG THE GENERATOR OF A BODY OF REVOLUTION
B. V. Alekseev [1967] 6 p refs Transl. into ENGLISH from Vychislitel'naya Mat. i Mat. Fiz. (USSR), v. 7, no. 4, 1967 p 929–933

Systems of equations describing the flow of a μ-component chemically nonequilibrium gas in the boundary layer, are presented. Certain nondimensional functions are introduced. The boundary conditions of a problem concerning a gas phase consisting of a mixture of four components CO, CO_2, O, and O_2 is examined. Formation mass rates, flow conditions, heats of reaction, surface temperatures, friction stress, and mass entrainment parameters are incorporated in the differential equations used in the problem. L.S.

N68-10646* Stanford Research Inst., Menlo Park, Calif.
IMPLOSIVELY ACCELERATED SHOCK TUBE DRIVER
Stephen P. Gill and Robert C. Goettelman Washington NASA Nov. 1967 66 p refs
(Contract NAS2-3129)
(NASA-CR-950) CFSTI: $3.00 CSCL 14B

The feasibility of using an implosive driver in a shock tube facility for research in high energy gasdynamics was investigated. Two implosive shock tube systems, one using a jetting driver and the other a jetless driver, were used to drive shock waves at velocities from 11 to 15 km/sec into dry air at initial pressures in the range 0.5 to 5 torr. The characteristics of the driver were investigated in a combined experimental and theoretical program, and the high energy gas flow behind the shock front was studied to determine experimentally its uniformity, purity, duration, and quality. It is concluded that the jetting driver, which consists of a cylinder of high explosive that progressively collapses a glass tube and projects a diffuse glass jet into the shock tube, can be of significant value as a shock tube driver for initial test gas pressures less than 1 torr. The diffuse glass jet is as effective as a perfect piston at these pressures, and a plane shock of nearly uniform velocity is driven into the test gas, followed by high energy flow of exceptional uniformity, quality, and purity. In addition, the test time grows at a rate nearly equal to that calculated for a perfect piston, and is insensitive to boundary layer phenomena. Author

N68-10779 National Aerospace Lab., Tokyo (Japan).
EXPERIMENTAL STUDY OF AN ORIFICE-TYPE PRESSURE PROBE IN NEARLY-FREE-MOLECULE FLOW
Akira Onji and Kiyoshi Yamamoto May 1967 24 p refs In JAPANESE; ENGLISH summary
(NAL-TR-136)

The theory developed for free-molecule flow can be extended to the case of *nearly*-free-molecule flow by introducing an additional term in the expression of the velocity distribution function. The authors applied this theory to the orifice-type pressure probe, and showed that the pressure inside of this probe was related to the first moment of the velocity distribution function. In order to check the theory, the authors carried out several experiments in the rotating-arm apparatus using air and Freon as test gases: measurements were made with orifices located on the models of spheres, circular disks, and cylinders of various size. The range of Knudsen number was varied from 0.1 to 20; the speed ratio was 0.22 to 1.60. Thermistor gauges, specially calibrated, were used to measure the pressure and the temperature. The results were compared with theoretical ones based on the theories by Willis and Liu et al. The agreement was fairly good in the range $K_n > 3$. Especially when the speed ratio is small enough, measured values showed smooth intermediate change from the free-molecule to the continuum regime for all bodies and orifice locations. However, the existing theories did not explain well the data for $K_n > 3$. Author

N68-10820# Ohio State Univ. Research Foundation, Columbus. Dept. of Mechanical Engineering.
THE DETECTION OF ELECTRICALLY-INDUCED SECONDARY FLOWS IN A PIPE BY MEANS OF ELECTROSTATIC PROBES
Henry R. Velkoff and Edwin R. Pejack Aug. 1967 55 p refs
(Contract DA-31-124-ARO(D)-246)
(AROD-4942-7-E; TR-7; AD-659396)

An experimental investigation was conducted to detect the presence of electrically induced secondary flows inside a round pipe. A thin concentric wire in the pipe was impressed with a high positive voltage which generated a corona discharge, producing ions and a radial electric field in the pipe. It was postulated that secondary flows taking the form of vortex flows inside the pipe would result. A technique of utilizing electrostatic probes inserted into the pipe and on the wall provided strong evidence that secondary flows were generated both with and without a primary axial flow. At zero axial flow the characteristic length of the secondary flow was on the order of two pipe diameters. With an axial flow, when the primary and secondary flows are superimposed, various characteristic lengths were observed. Author (TAB)

N68-10838# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CALCULATION OF HYPERSONIC AXISYMMETRIC JETS
V. N. Gusev 8 Jun. 1967 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidicosti i Gaza (USSR), no. 1, 1967 p 107–109
(TG-230-T526; TT-67-62981; AD-659185)

Discussion is given of the problem of supersonic flow of an ideal, thermodynamically perfect gas expelled from a nozzle into a stationary medium. An approximate analytical solution of the problem is obtained and applied to several examples, specifically, design, over-expanded and under-expanded nozzles. Author (TAB)

N68-10974 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
ANALYTIC STUDY OF TWO MODELS OF GAS-SURFACE INTERACTION IN FREE MOLECULAR STATE [ETUDE ANALYTIQUE DE DEUX MODELES D'INTERACTION GAZ - SURFACE EN REGIME MOLECULAIRE LIBRE]
D. de Heering Jun. 1967 55 p refs In FRENCH
(VKi-TN-36)

Two three-dimensional models are considered for the interaction of a gas particle with a solid atom. Both models are derived from a model developed by Trilling, Wachman, and Scott that estimates the tangential accommodation coefficient as the gas particle approaches the solid surface; and one of the models makes use of a rigid spheres method. A comparison is made of numerical calculations obtained by both models for the influence of angle of incidence on the energy accommodation coefficients and on the tangential movement. Details of the models are included. Transl. by M.W.R.

N68-10977 Aix-Marseilles Univ. (France). Institut de Mecanique des Fluides de Marseille.

ON THE FLOW IN A HYPERSONIC NOZZLE PIPE OF A DIATOMIC GAS BEYOND VIBRATIONAL EQUILIBRIUM, 2 [SUR L'ECOULEMENT DANS UNE TUYERE HYPERSONIQUE D'UN GAZ DIATOMIQUE HORS D'EQUILIBRE VIBRATOIRE, 2EME PARTIE]

J. C. Chaize, and H. Guenoche May 1967 21 p refs In FRENCH

(Contract DRME-66-190)

A comparison was made of the vibration temperatures, as measured by a reversal lines technique, in the flow leaving a hypersonic shock tube and that behind a shock attached to a dihedron introduced into the flow. Experimental and theoretical results are presented, and the shock tube and measurements techniques are described. Excitation temperature of sodium in an expanded gas was measured, as was the flow around a dihedron located between the surface and the attached shock. The temperature of sodium behind a shock attached to a dihedron in the flow leaving a shock tube was found to be the same as the temperature in the flow itself. Excitation temperature measurements of chromium are also presented in this study on diatomic gas flow. Transl. by M.W.R.

N68-10978 Aix-Marseilles Univ. (France). Institut de Mecanique des Fluides de Marseille.

HYPERSONIC AERODYNAMIC EFFECTS OF INCIDENCE ON FLOW AROUND SLENDER CONES WITH SHARP AND DULL POINTS [AERODYNAMIQUE HYPERSONIQUE EFFETS DE L'INCIDENCE SUR L'ECOULEMENT AUTOUR DE CONES MINCES A POINTE VIVE OU EMOUSSEE]

R. Brun and J. P. Guibergia [1967] 72 p refs In FRENCH

(Contract DRME-66-190)

A theoretical and experimental study is concerned with the aerodynamic effects of incidence angle on the flow around slender cones with sharp and blunt edges, with emphasis on sharp-edged cones at small incidence. Surface pressure and heat flux were measured for various conical models placed in hypersonic flow. Studies were made in a shock tunnel at free flow Mach number 9 and at temperatures as high as 4000°K. Measurements were made at the cone walls with 9 degree angles at the apex placed at incidence angles of from 3 to 6 degrees in relation to flow direction. Transl. by M.W.R.

N68-10979 Aix-Marseilles Univ. (France). Institut de Mecanique des Fluides de Marseille.

ON THE FLOW IN A HYPERSONIC NOZZLE OF A DIATOMIC GAS BEYOND VIBRATIONAL EQUILIBRIUM, 3 [SUR L'ECOULEMENT DANS UNE TUYERE HYPERSONIQUE D'UN GAZ DIATOMIQUE HORS D'EQUILIBRE VIBRATOIRE, 3EME PARTIE]

M. Billiotte and H. Guenoche May 1967 34 p refs In FRENCH

(Contract DRME-66-190)

The evolution of vibrational relaxation times of nitrogen in the relaxation zone of uniform shock propagation was studied in a hypersonic shock tube. The shock tube and measurement and correction methods are detailed, and results are analyzed according to equilibrium theory. The results presented do not correlate with previous calculations, which may be due in part to flow perturbations that occur after shock formation and introduce deviations from equilibrium theory calculations. Transl. by M.W.R.

N68-10981 Aix-Marseilles Univ. (France). Institut de Mecanique des Fluides de Marseille.

ON THE FLOW IN A HYPERSONIC BLAST NOZZLE PIPE OF A DIATOMIC GAS BEYOND VIBRATIONAL EQUILIBRIUM, 3 [SUR L'ECOULEMENT DANS UNE TUYERE HYPERSONIQUE D'UN GAZ DIATOMIQUE HORS D'EQUILIBRE VIBRATOIRE, 3EME PARTIE]

H. Guenoche and J. C. Loraud May 1967 60 p refs In FRENCH

(Contract DRME-66-190)

Calculations were made of flow beyond equilibrium around a dihedral configuration in a hypersonic shock tube, and a program was developed to obtain the flow between the wall of the dihedron and the shock wave attached to its apex. The upstream shock flow was in a state of nonequilibrium vibration, and the shock wave presented a curve of variable sign. Since the criterion of rectilinearity of the shock wave was not sufficiently precise to assure the placement of a diatomic gas in equilibrium, flow variables were measured at two different points. To verify the degree of variation, the flow beyond equilibrium vibration was calculated behind the shock attached to a dihedron. Transl. by M.W.R.

N68-10986*# Illinois Univ., Urbana.

ON HEAT TRANSFER WITHIN AND ACROSS NEARLY CIRCULAR CAVITIES INCLUDING THE EFFECTS OF VARIABLE WALL TEMPERATURE AND MASS BLEED

Ervin Lynn Bales (Ph.D. Thesis) 1967 100 p refs

(Grant NsG-13-59)

(NASA-CR-90233) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The flow and heat transfer in a nearly circular cavity with internal mass bleed and a non-isothermal wall were examined by systems models. A dissipative model was used to determine the velocity distributions in the shear regions, and these in turn were used in a heat transfer model to determine the temperature distribution and the accompanying heat transfer from and across the nearly circular cavity. Results from the numerical calculations indicate that reasonable results for either the constant wall temperature case or for step changes in wall temperature can be obtained. L.S.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-10022# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

BASIC FEATURES OF FORMATION AND DEVELOPMENT OF THE CAUCASUS IN CONNECTION WITH ITS DEEP-SEATED STRUCTURE [OSNOVNYYE CHERTY STROYENIYA I RAZVITIY KAVKAZA V SVIYAZI S YEGO GLUBINNOY STRUCTUROY]

A. A. Sorskiy Aug. 1967 19 p refs Transl. into ENGLISH from the book "Glubinnoye Stroyeniye Kavkaza" Moscow, Nauka Publishing House, 1966 p 22–34

(ACIC-TC-1225; TT-67-62938; AD-658712)

Because of geophysical achievements, the problems of the structure and development of the great downward flexures of the earths crust have become more timely. There is an apparent connection between superficial tectonic phenomena and the structure and development of the abyssal zones. Caucasus, a part of a vast Alpine folded zone is of special interest for a comparison between visible and abyssal tectonic structures. This translation is a detailed study of the geological structure. The study brings forth considerations which are only hypothetical and represent an attempt of outlining the general connections between the abyssal structure, the history of development and the tectonics of the Caucasus. The history of geological development indicates an extreme structural-historical differentiation of Caucasus. Geophysics together

with geology can achieve much in the studies of the abyssal fractures of the area. Many transverse profiles must be constructed in order to obtain a precise idea on the structure of the abyssal discontinuities within the limits of the Kura and Terek depressions. As a whole, only complex geological-geochemical-geophysical investigations can shed light on all the complicated aspects of the structure of the Caucasus, which will be important from the practical and theoretical points of view. Author (TAB)

N68-10030* Smithsonian Astrophysical Observatory, Cambridge, Mass.

A THREE-DIMENSIONAL MODEL OF THE UPPER ATMOSPHERE

Manfred P. Friedman 19 Sep. 1967 119 p refs

(Grant NsG-87-60)

(NASA-CR-89976; SAO Special Rept.-250) CSCL 04A

A theoretical formulation that is used for constructing three-dimensional models of the upper atmosphere is described. With this formulation temperatures and densities over the entire globe through the altitude range 120 to 800 km are computed. Equations are derived from the laws of conservation of mass, momentum, and energy, and the main input to the problem is solar radiational heating. The temperature and density of the atmospheric constituents O_3, N_2, O, He, and H at the base of the atmosphere, 120 km are prescribed. After having rewritten the conservation equations in difference form, some solutions are computed. Preliminary results of these calculations are presented. Author

N68-10032* Alaska Univ., College.

HIGH LATITUDE GEOPHYSICAL DATA

V. P. Hessler, ed. Jun. 1966 115 p

(Contracts NAS5-3595; Nonr-3010(01); AF 19(628)-1695)

(NASA-CR-89792; UAG-C-44) CSCL 04A

Tables and graphs of the geophysical data for April–June 1967 are presented and are briefly discussed. The data include: 30 Mc/s cosmic noise; N-S telluric current and amplitude; telluric fluctuation and micropulsation activities; telluric sonograms; and geomagnetic activity. N.E.N.

N68-10052# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE LOWER 300-METER LAYER OF THE ATMOSPHERE (SELECTED ARTICLES)

4 May 1967 62 p refs Transl. into ENGLISH from the book "Issledovaniye Nizhnego 300-Metrovogo Sloya Atmosfery" Moscow, Izd. AN SSSR, 1963 p 3–34

(FTD-MT-64-361; TT-67-62854; AD-658244)

Contents: Experiments on propagation of deposited impurity from point source in lower layer of atmosphere; On profiles of wind and characteristics of turbulent regime in the lower 300-meter layer of atmosphere; (Profiles of wind and temperature in surface layer of air, on profiles of wind and characteristics of the turbulent regime in the lower 300-meter layer of the atmosphere); Some results of measurements of horizontal diffusion of impurity in lower layer of atmosphere. Author (TAB)

N68-10053# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTS ON PROPAGATION OF DEPOSITED IMPURITY FROM POINT SOURCE IN LOWER LAYER OF ATMOSPHERE [OPYTY PO RASPROSTRANENIYU OSAZHDAYUSHCHEYSYA PRIMESI OP TOCHECHNOGO ISTOCHIKA V INZHNEM SLOYE ATMOSFERY]

A. K. Aleksandrova, N. L. Byzova, and G. B. Mashkova *In its* Invest. of the Lower 300-Meter Layer of the Atmosphere 4 May 1967 p 1–18 refs (See N68-10052 01-13)

In calculating the diffusion of either precipitating or weightless contaminants in the boundary layer of the atmosphere, a phenomenon which depends both on the properties of the contaminant particles and on the turbulence of the air, the maximum concentration of contaminants and the distance of this point from the source are of considerable interest. The authors therefore present the results of 53 experiments and derive formulas for these parameters on the basis of 2 systems of calculation, assuming either that the coefficient of vertical turbulent diffusion increases linearly with height, or that it is independent of height. For this purpose, 4 types of atmospheric stratification were distinguished (indifferent stratification and 3 degrees of instability), and inversions were not considered. The parameters of horizontal diffusion were determined by the type of stratification, while the position and magnitude of the maximum contaminant density and the length of the contaminated zone were determined by the ratio between the gravitational force and the turbulence. Author

N68-10054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON PROFILES OF WIND AND CHARACTERISTICS OF TURBULENT REGIME IN THE LOWER 300-METER LAYER OF ATMOSPHERE [O PROFILYAKH VETRA I KHARAKTERISTIKAKH TURBULENTNOGO REZHIMA V NIZHNEM 300-METROVOM SLOYE ATMOSFERY]

Z. I. Volkovitskaya and G. B. Mashkova *In its* Invest. of the Lower 300-Meter Layer of the Atmosphere 4 May 1967 p 19–35 refs (See N68-10052 01-13)

After reviewing the various techniques for calculating the wind profile in the lower levels of the atmosphere, with special reference to the methods of Obukhov–Monin and Monin–Kazanskiy, the authors apply these calculations to data on wind velocity and temperature obtained at 13 levels of a 300-meter meteorological tower between August and September of 1961. Particular attention is devoted to the profiles of wind and temperature in the layer nearest the ground. The relationship between these profiles and atmospheric turbulence and stratification is discussed, and changes in wind velocity during the day are tabulated. Author

N68-10055# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME RESULTS OF MEASUREMENTS OF HORIZONTAL DIFFUSION OF IMPURITY IN LOWER LAYER OF ATMOSPHERE [NEKOTORYYE REZUL'TATY IZMERENIY GORIZONTAL'NOY DIFFUZII PRIMESI V INZHNEM SLOYE ATMOSFERY]

N. L. Byzova *In its* Invest. of the Lower 300-Meter Layer of the Atmosphere 4 May 1967 p 37–52 refs (See N68-10052 01-13)

After a detailed mathematical treatment of the factors affecting diffusion of an aerosol from a point source in the lower atmosphere, the author analyzes the results of experiments carried out in 1959–61 at altitudes of 25–300 meters. During these studies, which provided 226 separate values at distances ranging from 100 meters to 10 km, the atmospheric stratification varied from neutral to highly unstable, and the rate of fall of the contaminant particles due to gravity was less than 0.3 meters/sec, so that diffusion in the vertical direction could be neglected. The data obtained are shown in Fig. 1 of the Enclosure. An extensive analysis of these results showed that the ratio between wind pulsation and wind velocity is essentially independent of height under conditions of indifferent or unstable stratification. Author

N68-10065* Adelphi Univ., Garden City, N. Y.

A COMPUTER PROGRAM FOR GRAPHICAL PRESENTATION OF AEROPALYNOLOGIC AND POLLEN STRATIGRAPHIC DATA

Leslie A. Sirkin and Charles J. Grossman [1966] 32 p refs
(Grant NsG-394)
(NASA-GR-89979) CSCL 08G

Programs for computer plotting of pollen data are described for the standard pollen diagram, for individual spectra in bar graph form, and for a combined diagram of pollen curves and bar graph spectra. These include: (1) a Fortran II program for use on a solid state, binary digital computer equipped with a subroutine program which activates the graphic output on an X–Y plotter; (2) a bar graph program written to emphasize the distribution of pollen types within a single spectrum derived either from a single sample or abstracted from the full pollen diagram; and (3) a combined graphic procedure and bar graph program for use where single pollen sampling stations or levels can be combined with multiple samples (sections or cores). M.G.J.

N68-10079*# Israel Program for Scientific Translations, Ltd., Jerusalem.
ELECTRICITY OF THE FREE ATMOSPHERE
I. M. Imyanitov and E. V. Chubarina 1967 216 p refs Transl. into ENGLISH of the publ. "Elektrichestvo Svobodnoi Atmosfery" Leningrad, Gidrometeorol. Izd., 1965 Published for NASA and NSF
(NASA-TT-F-425; TT-67-51374) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A general picture of the electric structure of the atmosphere on cloudy and cloudless days, based on data obtained in systematic aircraft soundings of the atmosphere's electric field, is presented. Detailed tables of the initial data are included as well as data on the structure of the fair weather electric field, on the distribution of electric space charges and potentials in these conditions, and on the electric structure of stratus clouds. The data were gathered during the International Geophysical Year and the Year of International Geophysical Collaboration. R.N.A.

N68-10147# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
MAIN RESULTS OF GEOPHYSICAL INVESTIGATIONS OF THE STRUCTURE OF THE EARTH'S CRUST IN THE BLACK SEA BASIN [OSNOVNYYE REZUL'TATY GEOFIZICHESKIKH ISSLEDOVANIY STROYENIYA ZEMNOY KORY CHERNOMORSKOGO BASSEYNA]
B. K. Balavadze and P. Sh. Mindeli Aug. 1967 13 p Transl. into ENGLISH of the book "Stroyeniye Chernomorskoy Vpadiny" Moscow, "Nauka" Publishing House, 1966 p 17–21
(ACIC-TC-1223; TT-67-62625; AD-656997)

The committee for the study of the structure and movement of the earths crust in the Black Sea basin drew up a plan for a series of thematic investigations. This investigation was designed to accomplish the complex study of this water basin and its surrounding areas. The subject was assigned to the Geophysical Institute of the Georgian Academy of Sciences in Simferopol in 1962. Results of investigations in this field, preliminary (1963) and final (1964) were presented in Crimea at successive meetings of the committee. The translation is a brief report of the findings: On the basis of seismic and gravimetric data, it is shown that the structure of the earths crust in this basin, like in other inland seas, is of the intermediate type. In the central part of the basin the granite later is absent and the thickness of the crust is 22-25 km, whereas on the seacoast it is 35-45 km. The thickness of the sedimentary complex increases from 5-8 km around the sea to 15 km in the central part of the sea. Author (TAB)

N68-10174 New Zealand. Dept. of Scientific and Industrial Research, Wellington.
THE GEOMAGNETIC FIELD IN NEW ZEALAND AT EPOCH 1960.5
A. L. Burrows 1967 50 p refs /ts Bull. No. 175 and Geophys. Memoir 6

The values of the magnetic elements reduced to Epoch 1960.5 are given for 241 land stations at which observations were made in New Zealand from 1941 to 1961. These data have been analysed and isomagnetic charts for all elements at Epoch 1960.5 are appended. For this Epoch the Total Force chart analysis is based on an additional 329 stations obtained from proton magnetometer measurements at sea, with stations 20 nautical miles apart. The westward drift of the component isolines in the South Island of New Zealand has been studied and found to be 0.26° in longitude per year. The values of the magnetic elements reduced to Epoch 1960.5 are also given for stations in The Snares, Auckland, Campbell, Chatham, Antipodes, and Bounty Islands. Author

N68-10180* Northwestern Univ., Evanston, Ill. Dept. of Geology.
THE GEOCHEMISTRY OF THE FREMONT LAKE QUARTZ MONZONITES AND ASSOCIATED GRUSS, NASA SONORA PASS GEOLOGICAL TEST SITE, SIERRA NEVADA, CALIFORNIA
Robert G. Garrett 17 Nov. 1967 40 p refs
(Grant NGR-14-007-027)
(NASA-CR-90048; Rept.-14) CSCL 08D

A study of the areal geochemical variability has been made of the Fremont Lake Quartz Monzonites and their associated weathering product, gruss. The chemical analysis for some 20 elements of 101 samples of surface material and bedrock was carried out to provide information which would help in the interpretation of data collected as part of the NASA geological remote-sensing program. The results have shown that the geochemistry of the gruss can be used as a guide to the nature of the underlying bedrock. During all stages of the work, a wide use of automated dataprocessing techniques has been made, in particular the use of multivariate statistical techniques to aid data interpretation. Author

N68-10240# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
DATA OF GRAVIMETRIC SURVEYS AND PROBLEMS OF DIRECT SEARCH FOR OIL AND GAS ON THE MONZHUKLY STRUCTURE [RESUL'TATY GRAVIMETRICHESKIKH ISSLEDOVANIY S ZADACHEY PRYAMYKH POISKOV NEFTI I GAZA NA STRUCTURE MONZHUKLY]
B. I. Kireyev Jul. 1967 6 p refs Transl. into ENGLISH from Razved. Geofys. (Moscow), no. 8, 1965 p 104–108
(ACIC-TC-1217; TT-67-62630; AD-656991)

Gravimetric measurements along three profiles were taken on the Monzhukly structure. A weak gravity minimum was noted in the crest part of the Monzhukly fold. I. G. Modoviskiy hypothetically explained its nature by the presence of screened gas and oil deposits in the northern part of the block of the fold. A detailed gravimetric survey was conducted for the determination of this minimum. This detailed survey made it possible to outline more precisely the general relative gravity maximum, corresponding to the structure, and to separate against its background a relative gravitational minimum. A comparison between the data of the gravimetric survey and the geological map distinctly shows the confinement of the minimum to the northern block of the fold. In the Monzhukly region, the given minimum could be caused by the influence of the terrain relief not being sufficiently taken into account, by errors in the determination of the Bouguer correction, by the presence of oil and gas deposits in the interior part of the fold, by the lithologic-structural characteristic of the fold. The paper discusses the above possibilities and explanations, with the conclusions drawn from the gravimetric and geologic studies. Author (TAB)

N68-10283*# Little (Arthur D.), Inc., Cambridge, Mass.
THE APPLICATION OF HIGH TEMPERATURE RADIATIVE THERMAL CONDUCTIVITY OF MINERALS AND ROCKS TO A MODEL OF LUNAR VOLCANISM

Washington, NASA Nov. 1967 73 p refs
(Contract NAS9-5840)
(NASA-CR-916) CFSTI: HC $3.00/MF $0.65 CSCL 08G

At the relatively high temperatures that probably exist deep in the lunar interior, heat flow takes place by both lattice conduction and radiative transfer. The radiative transfer which should be dominant at the higher temperatures is caused by a process of repeated emission and re-absorption of radiation modified by the effect of scattering by discontinuities such as inclusions or grain boundaries. The rate of emission depends on the blackbody spectral distribution at the temperature of the medium and on the optical constants n and k of the medium which are, in general, strong functions of the wavelength. The rate of re-absorption also depends on n and k. The scattering depends on the size and spatial distribution of the discontinuities in n and k. Author

N68-10284* Kansas Univ., Lawrence.
SOME APPLICATIONS OF RADAR RETURN DATA TO THE STUDY OF TERRESTRIAL AND OCEANIC PHENOMENA
Willard J. Pierson, Jr., Bernard B. Scheps, and David S. Simonett Mar. 1965 49 p refs Presented at the 3rd Goddard Mem. Symp. on Sci. Expt. for Manned Orbital Flight, Washington, D. C. 18–19 Mar. 1965
(Contracts NSR-17-004-003; Nonr-285(57))
(NASA-CR-89983; CRES-TR-61-3) CSCL 08B

The possibilities for scientific and practical research with imaging and altimeter-type radars mounted in orbiting spacecraft are discussed. An all-weather day-or-night capability for high resolution mapping and scattering cross-section studies is shown to be within the current state of the art and sophisticated multifrequency polypolarization coherent imaging systems are currently under study. Terrestrial applications of space-borne radar in geology, glaciology, geomorphology, pedology, and agriculture, and oceanic applications related to sea-state sensing are examined. R.N.A.

N68-10294# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
MEAN FREE AIR ANOMALIES: SOURCES OF INFORMATION ON HETEROGENEITIES IN THE EARTH'S MANTLE [OSREDNENNYYE ANOMALII FAYA-ISTOCHNIK INFORMATSII O NEODNORODNOSTYAKH V MANTII]
M. Ye. Artem'yev Jul. 1967 21 p refs Transl. into ENGLISH from Byul. Mosk. Obshchestva Ispytatelei Prirody, Otd. Geol. (Moscow), v. 40, no. 5, 1965 p 93–105
(ACIC-TC-1216; TT-67-62163; AD-656992)

Maps of mean free air anomalies of the entire earth by data of I. D. Zhongolovich, W. A. Heiskanen and W. M. Kaula are presented. These anomalies which are a substitute for the isostatic anomalies are evidently connected with the heterogeneities in the mantle, which encompass vast territories. Noted is the confinement of the strongest anomalies to regions of increased tectonic activity. The translation discusses the gravitational field of the earth in regard to density heterogeneities, free air anomalies and mean air anomalies. There is a comparison of maps of free air anomalies for the entire earth, constructed by different authors and by various methods. Certain conclusions were reached on the basis of different factual data. These conclusions are also presented. Author (TAB)

N68-10335# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
THEORETICAL CURVES FOR THE INDUCED POLARIZATION METHOD
L. L. Van'yan, G. M. Morozova, and L. V. Lozhenicyna Jul. 1967 9 p Transl. into ENGLISH from Geol. i Geofiz. Akad. Nauk SSSR, Sibirsk, Otd. (Novosibirsk), v. 10, 1961 p 118–123
(T-476-R; TT-67-62669; AD-657262)

The paper considers a new way of computing the apparent polarizability. TAB

N68-10338# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
STRUCTURE OF THE CRYSTALLINE BASE OF THE SOUTHEASTERN PART OF THE RUSSIAN PLATFORM AND ITS FRAMING, ACCORDING TO DATA OF AEROMAGNETIC SURVEY (Δ T) [STRUKTURA KRISTALLICHESKOGO FUNDAMENTA YUGOVOSTOCHNOY CHASTI RUSSKOY PLATFORMY I YEYE OBRAMLENIYA PO DANNYM AEROMAGNITOY S'YEMKI (Δ T)]
D. P. Kasatkin Jun. 1967 11 p refs Transl. into ENGLISH from Neftegaz. Geol. i Geofiz. (Moscow), 1966 p 34–37
(ACIC-TC-1236; TT-67-62633; AD-656993)

The paper presents the differences in formations of the Russian platform consisting of the Southern and Eastern framing regions together with the Southeastern region. This platform has been divided into five zones, and each zone is described in this translation. Author (TAB)

N68-10342* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORETICAL MOLECULAR LINE ABSORPTION OF CO IN LATE SPECTRAL TYPE ATMOSPHERES
Virgil G. Kunde (M.S. Thesis—Maryland Univ.) Jul. 1967 63 p refs
(NASA-TM-X-55990; X-622-67-336) CFSTI: $3.00 CSCL 04A

The line positions, line intensities, and collisional line half-widths have been calculated for the fundamental, first overtone, and second overtone vibration–rotation bands of $C^{12}O^{16}$ and $C^{13}O^{16}$. The line intensities were computed for temperatures ranging from 176–3500°K and were weighted in accordance with a terrestrial C^{12}/C^{13} abundance ratio. All lines within 5–6 orders of magnitude of the maximum line intensity of a band have been considered (≈4500 lines at 3500°K). The CO mass absorption coefficient has been computed for several late spectral type stellar atmosphere conditions. The straight mean absorption coefficient has been evaluated for these conditions in several ways: (1) exactly by using line-by-line integration techniques; (2) approximately by using the quasi-random molecular absorption band model, and; (3) approximately by computing the expression $S_T^m/\Delta\nu$ where S_T^m is the total line intensity in spectral interval $\Delta\nu$. Results of this investigation indicate the simpler $S_T^m/\Delta\nu$ approximation represents the CO mean absorption coefficient in the late type atmospheres generally to an accuracy better than 1% if the spectral intervals are greater than 5 cm^{-1}. Author

N68-10343# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
CORRELATION OF SEISMIC AND GRAVIMETRIC DATA ON THE STRUCTURE OF THE EARTH'S CRUST IN THE BLACK SEA DEPRESSION [SOPOSTAVLENIYE SEYSMICHESKIKH I GRAVIMETRICHESKIKH DANNYKH O STROYENII ZEMNOY KORY CHERNOMORSKOY VPADINY]
Ya. P. Malovitskiy and Yu. P. Neprochnov Aug. 1967 21 p refs Transl. into ENGLISH of the book "Stroyeniye Chernomorskoy Vpadiny, Sbornik Statey" Moscow, Nauka Publ. House, 1966 p 1–16
(ACIC-TC-1222; TT-67-62621; AD-656994)

Many geophysical investigations were made in the Black Sea depression. Their data shed new light on the abyssal structure and history of the geological development of this region. It has now become necessary to generalize and make a complex interpretation of the data obtained by different geophysical methods for the Black Sea with full use of the extensive geological-geophysical materials on the surrounding land sections. In this work, an attempt is made to explain the character of the connection between the gravitational anomalies in the Bouguer reduction and the abyssal structure of the earths crust of the Black Sea depression on the basis of a comparison between the abyssal seismic sounding data and gravimetry. Author (TAB)

N68-10345 International Geophysical Year World Data Center A, Washington, D. C. Coordination Office.
CATALOGUE OF DATA IN WORLD DATA CENTER A: AIRGLOW, IONOSPHERE, AURORA (INSTRUMENTAL), AURORA (VISUAL), COSMIC RAYS, GEOMAGNETISM, SOLAR ACTIVITY, 1 JULY 1957–30 JUNE 1967
Aug. 1967 165 p refs Supported in part by NSF

World Data Center (WDC) geophysical data exchange procedures are briefly summarized. All of the airglow, aurora, ionosphere, cosmic ray, geomagnetism, and solar activity data received by World Data Center A from 1 July 1957 to 30 June 1967 is recapitulated. E.C.

N68-10351 International Geophysical Year World Data Center A, Washington, D. C. Coordination Office.
CATALOGUE OF DATA IN WORLD DATA CENTER A: GRAVITY, TSUNAMI, SEISMOLOGY, LONGITUDE AND LATITUDE, METEOROLOGY, 1 JULY 1957–30 JUNE 1967
Aug. 1967 57 p Supported in part by NSF

Geophysical observations presented include all the gravity, tsunami, seismology, and longitude and latitude data collected by World Data Center A to 30 June 1967, and post-IGY/IGC meteorological data received to 30 June 1967. E.C.

N68-10369*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPORAL VARIATIONS OF MESOSPHERIC OXYGEN AND OZONE DURING AURORAL EVENTS
Kaichi Maeda and A. C. Aikin Washington, NASA, Nov. 1967 36 p refs
(NASA-TN-D-3993) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Temporal solutions are given for the photochemical equations describing the distribution of ozone and atomic oxygen in an oxygen atmosphere for the equatorial and polar regions. Similar calculations are applied to auroral events. These calculations indicate a strong dependence of the distribution of mesospheric atomic oxygen on the intensity and energy spectrum of auroral electrons that dissociate molecular oxygen. It is shown that there can be no significant atmospheric ozone and atomic oxygen modifications due to soft spectrum electron events which appear to characterize most bright auroras. The hard spectrum auroral electrons which appear in most weak, quiet auroras should cause significant increases in the atomic oxygen and ozone concentrations below 80 km, provided that their flux is more than 10^8 per cm^2 sec. Author

N68-10379# Sandia Corp., Albuquerque, N. Mex.
THE FEASIBILITY OF RAPID SOIL INVESTIGATIONS USING HIGH-SPEED, EARTH-PENETRATING PROJECTILES
W. N. Caudle, A. Y. Pope, R. L. McNeill (Woodward-Clyde-Sherard and Associates), and B. E. Margason (Woodward-Clyde-Sherard and Associates) [1967] 23 p refs Presented at the Intern. Symp. on Wave Propagation and Dyn. Properties of Earth Mater., Albuquerque, N. Mex., Aug. 1967 Prepared for AEC
(SC-DC-67-1922; CONF-670804-3) CFSTI: HC $3.00/MF $0.65

A new method for remote and rapid soil investigations is described. Since 1962, about 700 full-scale earth penetrations have been accomplished using long, slender, instrumental projectiles dropped from aircraft. The projectiles contain accelerometers and other instruments, and they broadcast their decelerations during earth penetration through a long trailing antenna. The decelerations experienced by the projectile are used to estimate material properties. The entire determination is done from the air, and the resulting profile data identifies weak and strong soils, granular and cohesive soils, and layer interfaces including bedrock. The profile data are similar to those from a Standard Penetration Test, and can be used with about the same confidence. A penetrator system is described for rapidly determining profiles in remote or inaccessible areas on land or under water. Author (NSA)

N68-10382 Defence Research Board, Ottawa (Ontario).
ALOUETTE 1 IONOSPHERIC DATA, ALOSYN, 1 MAY 1964 TO 15 MAY 1964
1 Jan. 1967 169 p

Topside sounder synoptic data consisting of selected ionospheric parameters obtained from Alouette I ionograms are tabulated. Also included are a list of the telemetry stations which recorded the sounder data and an explanation of the symbols used in the tabulations. R.N.A.

N68-10383 Defence Research Board, Ottawa (Ontario).
ALOUETTE 1 IONOSPHERIC DATA, ALOSYN, 16 MAY 1964 TO 31 MAY 1964
1 Jan. 1967 136 p

Tables of Alouette topside sounder synoptic data are presented which consist of selected ionospheric parameters obtained from Alouette I ionograms. The telemetry stations which recorded the sounder data are listed and the symbols used in the tables are explained. R.N.A.

N68-10387* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEMIGROUP SOLUTION OF THE TIME DEPENDENT CONTINUITY EQUATION FOR THE ION DENSITY IN THE IONOSPHERIC F2 LAYER
Brian Kritt Jul. 1967 15 p refs
(NASA-TM-X-63013; X-621-67-356) CSCL 04A

The continuity equation for the ion density in the F2 region is a valuable tool for studying the structure of this region. However, the theory of semigroups and their perturbations have not been used to obtain solutions for the time dependent equation. An introduction to the semigroup theory and its application to the continuity equation is presented. The perturbation method is used to solve a particular simple form of the continuity equation so that the analytical details of the method can be carried out. The physical problem which gives rise to the continuity equation is given followed by a discussion of the semigroup theory and its application to partial differential equations of a general type. These considerations are then specialized to obtain the semigroup solution of the continuity equation. Author

N68-10414 Technische Hogeschool, Eindhoven (Netherlands).
ON THE MECHANISM OF THE GENERATION OF PETROLEUM
Jan Willem Jurg (Ph.D. Thesis) 26 Sep. 1967 56 p refs

Current thinking on the origin and generation of crude oil is reviewed, including the generation of hydrocarbons from a straight chain fatty acid. Experiments were conducted to determine if the water in sediments was a significant factor in petroleum generation, and behenic acid and clay were mixed with enough water to insure its presence as a liquid at the temperature of heating. At temperatures around 250°C, hydrocarbons and fatty acids were generated from the behenic acid–clay mixture, although less hydrocarbon resulted in experiments with water than without. It is concluded that because isomerization is strong in the experiments without water, carbonium ions act as intermediates in the generation of low molecular weight hydrocarbons; while the water experiments with less isomerization produce radicals as intermediates. In both the water and waterless experiments, radicals were the intermediates in the formation of long chain n-alkanes and fatty acids; and a mechanism is suggested for the generation of homologous series of these long chains from an even-numbered fatty acid. M.W.R.

N68-10428# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
SOME RESULTS OF A STUDY OF THE DEEP SEATED STRUCTURE OF THE EARTH'S CRUST IN THE BLACK SEA DEPRESSION AND ADJACENT AREAS [NEKOTORYYE REZUL'TATY IZUCHENIYA GLUBINNOGO STROYENIYA ZEMNOY KORY CHERNOMORSKOY VPADINY I PRILEGA-YUSCHIKH TERRITORIY]
V. Ye. Burakovskiy Aug. 1967 11 p refs Transl. into ENGLISH from the Publ. "Stroyeniye Chernomorskoy Vpadiny" Moscow, Nauka Publ. House, 1966 p 22–26
(ACIC-TC-1224; TT-67-62624; AD-656996)

Some results of an analysis of the gravitational field of the Black Sea depression and of the adjoining territory along deep seismic sounding (DSS) profiles are presented. The gravity effect created by all the division surfaces of the earths crust located by DSS is calculated. The fact is established of a discrepancy in the gravitational field and the behavior of the deep crust division surfaces in the western part of the water area. This established discrepancy is put forward as a proof of the different structure of the earths crust in the western and eastern parts of the Black Sea water area. Author (TAB)

N68-10514# Milan Univ. (Italy).
A COUNTER FOR THE MEASUREMENT OF THE ATMOSPHERIC AND EARTH LEAKAGE FLUX OF SECONDARY COSMIC RAY NEUTRONS
R. Ballerini, G. Boella, A. Igiuni, P. Inzani, and L. Scarsi 15 May 1967 43 p refs
(Contract AF 61(052)-808)
(AFCRL-67-0493; SR-6; AD-659375)

A detailed description is given of a neutron counter employed in a combined balloon and rocket experiment, in which the integrated flux of neutrons of energy up to about 20 MeV has been measured as a function of atmospheric depth from 0.1 to 800 gr/sq cm residual pressure. The construction of the Boron-plastic scintillator detector and its operation in phoswich with a plastic scintillator, which suppresses charged-particle background, are discussed. Complete circuit diagrams of the counter electronics and telemetry transmission are given, and the mechanical solutions of the environmental problems involved in the rocket launch are fully described. Author (TAB)

N68-10565# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Flight Research Dept.
A STATISTICAL MODEL OF ATMOSPHERIC TURBULENCE AND A REVIEW OF THE ASSUMPTIONS NECESSARY FOR ITS USE
Francis E. Pritchard 1966 30 p refs Presented at the AGARD Specialists' Meeting on Stability and Control, Cambridge, England, 20–23 Sep. 1966
(Contract AF 33(615)-1883)
CFSTI: HC $3.00/MF $0.65

With the advent of larger, faster, more flexible airplanes that are intended for more exacting and extreme mission requirements, it has become important to assess carefully all aspects of manned flight. The atmospheric turbulence environment of the airplane is one aspect of flight that has recently been undergoing intensive research. This paper presents an updated and extended statistical model of atmospheric turbulence and discusses the common assumptions that are used to simplify this turbulence model as well as earlier models. Author

N68-10605 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOCK RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 168
17 Nov. 1967 11 p refs
(JPRS-43359; TT-61-11147-168)

Abstracts of scientific articles and selected news items, mainly from Soviet sources, are presented. Besides material on astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research, two separate articles on space matters are featured: a summary of the Venus-4 exploration of Venus, and a description of the Soviet Orbita Communication System. E.C.

N68-10606# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.
THE INTERACTION OF INTERNAL GRAVITY WAVES WITH THE IONOSPHERE AT THE F_1 AND F_2 LEVELS
Dimitri S. Bugnolo 5 Jul. 1967 35 p refs
(Contract Nonr-266(84))
(CU-166-67-ONR-266-Phys.; TR-140; AD-659173)

A first order theory is developed to describe the motions of electrons and ions in a weakly ionized gas in the presence of a magnetic field when the gas is disturbed by the passage of a low-frequency wave such as an internal gravity wave. The theory includes the effects of electron-ion coupling through the elastic electron-ion collisions, nu ei. The approximations are believed to be compatible to the case of an internal gravity wave in the F1 and F2 levels of the earths ionosphere. The results of the theory are compared to the results of the uncoupled theory (nu ei identical with 0). Calculations for a number of special cases indicate that the coupled theory must be used in the F region for all velocity components other than the vertical motion of the electrons. This component is adequately described by the results of the uncoupled theory for all cases of practical significance. Author (TAB)

N68-10643# Arecibo Ionospheric Observatory, Puerto Rico.
RESEARCH IN IONOSPHERIC PHYSICS Summary Technical Report No. 11, 1 Feb.–31 Jul. 1967
Frank D. Drake 31 Jul. 1967 125 p refs
(Contract F44-620-67-C-0066)
(RS-71; AFOSR-67-2307; AD-659439)

The Summary Technical Report No. 11 summarizes the research at the Arecibo Ionospheric Observatory from 1 February 1967 - 31 July 1967. The report includes discussion of work on the facility, brief discussions of the various research programs, a list of publications and personnel, and a table summarizing accomplishments. Ionospheric studies include measurements of the photoelectron flux, collection of double-pulse data, estimates of ion-neutral collision frequencies, correlations of meteor activity and nighttime E-region electron density, observations of traveling ionospheric disturbances using phase-path sounders and backscatter dish simultaneously, and F-region transport, density gradients, content, and slab thickness. The radar astronomy studies include observations of Venus, Mercury, and the Sun; and dual-frequency lunar observations at 10mus pulse widths. In radio astronomy, the research includes lunar occultation of cosmic radio sources, measurement of apparent angular size of radio sources with two telescopes separated by thousands of miles and not connected electrically, program for locating the positions of a large number of radio sources rapidly, observations of planetary scintillations, and tests of observations at the OH line. Author (TAB)

N68-10661# Stanford Research Inst., Menlo Park, Calif.
LIDAR OBSERVATIONS OF THE PRE-GONDOLA I CLOUDS Final Report
John W. Oblanas and Ronald T. H. Collis Jul. 1967 74 p refs Prepared for Calif. Univ., Livermore
(Contract AT(04-3)-115)
(PNE-1110) CFSTI: HC $3.00/MF $0.65

Lidar (laser radar) observations of the dust and steam clouds that resulted from the Pre-Gondola I series of four chemical explosions made near Fort Peck Reservoir, Montana, during October to November 1966 are described. The neodymium lidar was well able to track the clouds even when they became too tenuous to be

seen visually or photographed. Observational data were analyzed to obtain cloud dimension, height, volume, rate of growth, volume backscatter coefficient and relative density variations. It is concluded that lidar tracking techniques can provide unique information on the position, motion, rate of growth, and internal structure of visible and sub-visible clouds resulting from large-scale explosions, and recommendations are made for improving the operational efficiency of the technique. Author (NSA)

N68-10677 Joint Publications Research Service, Washington, D. C.

ATMOSPHERIC EFFECTS ON SATELLITE MEASUREMENTS OF RADIATION TEMPERATURE OF EARTH'S SURFACE

V. L. Gayevskiy and Yu. I. Rabinovich 22 Nov. 1967 17 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. Im. A. I. Voyeykov (Leningrad), no. 166, 1964 p 247–260
(JPRS-43413) CFSTI: $3.00

Atmospheric effects on the accuracy of earth radiation measurements are reviewed followed by a discussion of the development and application of an airborne instrument system for measuring earth surface temperatures. Thermoelement design characteristics are given and equations are derived to estimate performance potential. Results are given for experimental radiation measurements recorded over the water surface of the Caspian Sea, the Gulf of Finland, the White Sea, and over snow covered inland regions, at altitudes ranging from 100 to 6000 meters. Observations were recorded during different seasons and for different atmospheric stratifications. Water content vapors ranged from 0.2 to 3.6 cm of precipitated water and surface temperatures ranged from −27 to 26°C. Typical profiles of atmospheric stratifications and radiation temperatures are tabulated. Data comparisons indicate that average radiation temperature values and meteorological data did not exceed 1.5 degrees. Also, the radiation capacity of the majority of the natural surfaces was close to unity, and the difference between true and radiation temperatures, when averaged for the area, was relatively minor. E.C.

N68-10678# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics.

A NOMOGRAPHIC REPRESENTATION OF THE GEOID

Walter Messcher (Northeastern Univ.) 28 Aug. 1967 13 p refs *Its* Paper No. 2
(Contract Nonr-00014-67A-0298)
(TR-2; AD-659456)

This report employs a principle of duality that for every graphical mapping of the relationships among three variables there exists a nomograph or concurrency chart and it extends the idea to the analysis of geographical distributions considered as surfaces. Author (TAB)

N68-10682# Aeronautical Chart and Information Center, St. Louis, Mo.

TECTONIC STRUCTURE OF THE YAKUTIAN AUTONOMOUS SOVIET SOCIALIST REPUBLIC

1967 417 p refs Transl. into ENGLISH of the Publ. "Tektonicheskoye Stroyeniye Yakutskoy ASSR" Moscow, Nauka, 1964 p 1–291
(ACIC-TC-1148; AD-658715)

The translation is a discussion of the tectonic structure of the Yakutian Autonomous SSR. Various commercial minerals were disclosed in this area. In order to provide a scientific base for detection of these minerals, a seven-year period of extensive geological studies is being conducted. An attempt is being made to find laws governing the distribution of commercial minerals. This is the first works on tectonics of Yakutia taken as a whole. It contains personal observations by the authors. As far as possible, the whole complex of existing geological and geophysical data was taken into consideration for the compilation of the tectonic map of Yakutia, since the completed geological studies of it were of a very diverse quality. The existing tectonic charts and diagrams of different scales were taken as a base for relatively small sections. Author (TAB)

N68-10707# Naval Oceanographic Office, Washington, D. C.

EVALUATION OF THE ACCURACY OF THE GRAVIMETRIC CHARTS [K VOPROSU OB OTSENKE TOCHNOSTI GRAVIMETRICHESKIKH KART]

Vincenc Vyskocil 1963 15 p refs Transl. into ENGLISH from Studia Geophys. Geodaet., Ceskoslov. Akad. Ved. (Prague), v. 7, 1963 p 134–145
(NOO-Trans-361; TT-67-63054; AD-659564)

The paper attempts to demonstrate the determination of accuracy of charts showing the anomalies of gravity force and the investigation of the values in the interpolation field. The methods used in the calculation of some of the given characteristics of accuracy have not yet been fully developed. The theoretical substantiation of the characteristics of accuracy may, however, serve as a basis for practical studies in the accuracy of gravimetric charts. Author (TAB)

N68-10714# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.

STANDARD ATMOSPHERIC SUPPLEMENTS, 1966 Final Report, 1 Jul. 1966–31 Mar. 1967

Raymond A. Minzner Jul. 1967 30 p refs
(Contract AF 19(628)-6085)
(GCA-TR-67-8-A; AFCRL-67-0444; AD-659160)

Tables of the U. S. Standard Atmosphere 1962 were computed and tabulated up to only 90 km as functions of integer kilometer values of both geometric and geopotential altitudes. The geopotential tables have now been extended to 120 km altitude. This extension involved the development of an empirical function relating geopotential to geometric altitude. A discussion of this function along with limited geopotential tables was prepared for the U. S. Standard Atmosphere Supplements 1966. This function has also been used to prepare more extensive tables relating geopotential to geometric altitude and vice versa up to 10,000 km for latitudes from 0 to 90 degrees. In addition, a computer method was developed for automatically generating multilayer atmospheric models which rigorously fit arbitrary upper and lower boundary conditions. Author (TAB)

N68-10722 National Physical Lab., New Delhi (India). Radio Science Div.

EFFECTS OF EAST–WEST HORIZONTAL DRIFTS ON THE DIURNAL VARIATION OF ELECTRON DENSITY IN THE EQUATORIAL F REGION

B. C. Narasinga Rao 15 Aug. 1967 20 p refs
(RSD-S36; SR-36) CFSTI: HC$3.00

The effects of east–west horizontal drifts are studied theoretically and the effects are evaluated by comparing the solutions of the continuity equation with and without the drift term in addition to the production and loss terms. For a variable drift velocity of a simple sinusoidal form it is found that (1) the forenoon values are increased and the afternoon values are slightly decreased and (2) the daytime peak is shifted into the forenoon. The consequences of these results are discussed in relation to the observed diurnal variation of f_0F_2 in the equatorial zone. Author

N68-10726 National Physical Lab., New Delhi (India). Radio Science Div.

ELECTRON DENSITY DISTRIBUTION IN THE BOTTOMSIDE F REGION OF THE EQUATORIAL IONOSPHERE

B. C. Narasinga Rao 15 Aug. 1967 20 p refs
(RSD-S37; SR-37) CFSTI: HC$3.00

The height distribution of electron density was examined from the published tables of true height data of the equatorial station Huancayo (2°.0 N dip). The results showed that at midnight the height distribution followed α-Chapman profile, and at midday it followed linear distribution excepting near the peak of the layer. The models of equatorial F region are given for both sunspot maximum and sunspot minimum conditions. The gradient of the normalised linear distribution at midday is 0.3 per 100 km during sunspot maximum and 0.5 per 100 km during sunspot minimum, indicating that the layer is thinner during the lower solar activity period. The scale heights derived from the nighttime α-Chapman profiles decreased from 80 km in sunspot maximum to 30 km in sunspot minimum. Further, the nighttime scale heights were found to correspond to those of the ionizable constituent, atomic oxygen.
Author

N68-10728 National Physical Lab., New Delhi (India). Radio Science Div.
SATELLITE BEACON STUDIES OF THE IONOSPHERE OVER DELHI
Tuhi Ram Tyagi 1 Aug. 1967 20 p refs Submitted for publication
(RSD-534; SR-34) CFSTI: HC$3.00

The results of the analysis of the total electron content (I_s) measurements made from the Faraday fading records of the 20 and 40 MHz transmissions of the satellite S-66 for the period October 1964 through September 1966 are presented. The average maximum electron content value during winter, summer, and equinox is about $1.45\times10^{17}m^{-2}$, $3.25\times10^{17}m^{-2}$, and $3.35\times10^{17}m^{-2}$. The corresponding minimum values are $0.18\times10^{17}m^{-2}$, $0.25\times10^{17}m^{-2}$, and $0.15\times10^{17}m^{-2}$. Higher gradients are always observed in I_s values towards lower latitudes than towards higher latitudes from the observing station. It is further noted that gradients during daytime are higher than during nighttime. The effect of sunrise on gradients is presented. The dependence of electron content on solar activity, magnetic activity and solar zenith angle is studied. Scintillation occurrence is maximum around 02–04 hrs IST and is substantially high around 21–22 and 11–12 hrs IST. There is linear correlation between scintillation index at 20 MHz and f_0E_s.
Author

N68-10746# Texas A&M Univ., College Station. Dept. of Oceanography.
AN OBJECTIVE METHOD FOR DETERMINATION OF THE STREAM-FUNCTION FOR THE NON-DIVERGENT PART OF OBSERVED OCEANIC SURFACE CURRENTS
Andrew E. Garcia and Robert O. Reid Aug. 1967 46 p refs
(Contract Nonr-2119(04))
(AD-659175)

Objective techniques were utilized for determining the streamfunction for the non-divergent part of a two-dimensional vector field, specifically the surface currents as observed in the Eastern Gulf of Mexico during Cruise 66-A-8 of the Texas A+M University research vessel ALAMINOS in the period 5-22 June 1966. Geomagneticelectrokinetograph data gathered during this cruise were utilized to obtain a two-dimensional vector field with values of the surface current velocity displayed at discrete points on a regularly spaced grid. These values of surface current velocity were employed to estimate the vorticity field from which the streamfunction was estimated at fixed grid points by numerically integrating a form of Poissons equation with appropriate boundary conditions. Several types of boundary conditions were applied to the boundaries of the region in order to determine that condition which would result in the greatest consistency with the observed GEK vector field.
Author (TAB)

N68-10747# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
REGIONAL AND ZONAL ANOMALIES OF THE GEOMAGNETIC FIELD IN THE EUROPEAN PART OF THE USSR [REGIONAL'NYYE I ZONAL'NYYE ANOMALII GEOMAGNITNOGO POLYA YEVROPEYSKOY CHASTI SSSR]
A. A. Borisov and G. I. Kruglyaskova Sep. 1967 7 p refs Transl. into ENGLISH from Sov. Geol. (Moscow), no. 1, 1967 p 127–130
(ACIC-TC-1253; TT-67-63056; AD-659645)

In connection with the studies of the earths abyssal structure problems of segregation and interpretation of the anomalies of the geomagnetic field become more and more important. Obtained data was used for the compilation of a single map of the anomalous magnetic field of the whole European part of the territory of the USSR for the height of 20 km. The basic mass of local anomalies, caused by near-surface small bodies, is not reflected on the indicated map. Therefore, the regional and zonal features of the field are distinctly expressed. The presented data indicate that the different order anomalies, separated at different heights, actually reflect the structural properties and conditions of the various layers in the interior of the earth. In addition, the deepest zonal anomalies can be connected with the arrangement of the magnetoactive masses and with the phenomena of electric currents created by a physical-chemical process.
TAB

N68-10750# RAND Corp., Santa Monica, Calif.
HARMONIC ANALYSIS FOR A SPHEROIDAL EARTH
Anne B. Kahle Sep. 1967 13 p refs Presentation at the Intern. Union of Geodesy and Geophys. Assembly at St. Gall, Switz., Sep. 25–Oct. 7, 1967
(P-3684; AD-659361)

Spherical harmonic coefficients as usually derived from analysis of geomagnetic data on the spheroidal surface of the earth do not represent a true potential function. These coefficients differ significantly from those derived from a correct analysis of the same field extrapolated to a reference sphere, the largest difference being about 120 gamma in the g subscript 3 superscript o term. These differences are particularly important for subsequent extrapolation of the field either upward into the magnetosphere or downward toward the core. For instance, the position of a conjugate point as determined by a computer integration along a field line, can differ by more than 30 km. Using a simple computer program, some recent and older analyses have been modified to refer them to a sphere. Of several recent analyses suggested for consideration in selection of an international reference field, only one was originally referred to a true sphere. Since the sets are thus not consistent, the suggested selection of a simple median of these sets would not be desirable. The corrections required for the spheroidal shape of the earth and the implications of these corrections for the usage of the international reference field are factors to be considered in its selection.
Author (TAB)

N68-10781# Naval Oceanographic Office, Washington, D. C.
PROPERTIES OF HYDROLOGICAL AND HYDROCHEMICAL CONDITIONS IN THE SOUTH BALTIC DURING THE IGY [OSOBENNOSTI GIDROLOGICHESKIKH I GIDROKHIMICHESKIKH USLOVIY V YUZHNOY BALTIKE V PERIOD MGG]
A. Ye. Antonov and O. S. Rudneva 1967 10 p refs Transl. into ENGLISH from Okeanol. Issled. Sb. Statei (USSR), no. 13, 1965 p 90–95
(NOO-Trans-295; TT-67-63044; AD-659554)

The period of IGY embranced the culmination of freshening cycle of the Baltic Sea (1957-1958) and the beginning of a new salinity cycle (1959). In 1958, that is in the period of the maximum stagnation development of the waters of the Southern Baltic, the minimum salinity content were observed. The phosphate the silicic acid amount was very large. The salinity and temperature of the total water column were the lowest over the last 15 years. In

1959 there was a complete renewal of the bottom layers of the Southern Baltic, which was followed by sharp increase of salinity, temperature, dissolved oxygen and decrease of biogenetic elements. These processes occurred as a result of the inflow of saline waters of the north seas. In the next five years, large development of western circulation, increase of the river discharge, decrease of the icing and some increase of salinity of the bottom waters of the Southern Baltic must be expected. Author (TAB)

N68-10819# Naval Oceanographic Office, Washington, D. C.
CALCULATION OF TRANSPORT AND TEMPERATURE CHANGES IN THE UPPER WATER LAYER OF NORTH ATLANTIC OCEAN [RASCHET PERENOSA I IZMENENIY TEMPERATURY VOD VORKHNEGO SLOYA SEVERNOY ATLANTIKI]
L. A. Zhukov 1967 13 p refs Transl. into ENGLISH from Okeanol. Issled. Sb. Statei (USSR), no. 13, 1965 p 82–89
(NOO-Trans-294; TT-67-63043; AD-659553)

An attempt to calculate temperature changes of the upper 200 meter layer in vertical direction for autumn seasons of IGY and for the normal year. The wind stress and the heat exchange through the surface of the ocean and through the lower boundary of the layer are taken into account. The solution of the equations of motion and heat transfer is made by a numerical method on the electronic digital computer. The results of computation show that the heat conditions over North Atlantic in the autumn of 1958 were more normal, than in 1957 when a negative heat anomaly was observed in the Gulfstream system. Author (TAB)

N68-10843# Texas A&M Univ., College Station. Dept. of Oceanography.
THE SPACE OCEANOGRAPHY PROJECT Status Report, 1 Jun.–1 Sep. 1967
Luis R. A. Capurro 1 Sep. 1967 17 p refs
(Contract Nonr-2119(04))
(AD-659174)

The present status report covers the period from 1 June to 1 September, 1967. The background information of this effort as well as the scientific objectives of the present research program were stated in the Status Report on SPACE OCEANOGRAPHY PROJECT for February 1966 to October 1966. The report describes two successful aircraft flights that were made over the Mississippi Delta region in June and August, 1967. The first of these flights, Mission Number 50, was flown on 12 June 1967 by the NASA 926 CV-240A; there was no ground truth being gathered during this mission. The second of these flights, Mission Number 58, was flown on 30 August 1967 by the NASA 927 P3A; extensive ground truth was gathered on this mission by the Texas A and M University research vessel the R/V ALAMINOS. The report describes new research that has started which is concerned with the use of passive microwave radiometers in determining the temperature, salinity and roughness of natural water surfaces. The status of other research efforts begun earlier are described. A summary of project staffing, facilities and capabilities is given. Author (TAB)

N68-10844# Stanford Research Inst., Menlo Park, Calif.
GEOMAGNETIC DATA, BANGKOK, THAILAND—JANUARY–MARCH 1966
Douglas J. Barnes and John Chapman Mar. 1967 19 p
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-659407)

The report contains illustrations and tables of the geomagnetic field intensity at Bangkok, Thailand, for the period January-March 1966. TAB

N68-10850*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THE STRUCTURE OF THE THERMOSPHERE AND ITS VARIATIONS
Isadore Harris and Wolfgang Priester (Bonn Univ.) Oct. 1967 38 p refs
(NASA-TM-X-60604) CFSTI: HC $3.00/MF $0.65 CSCL 04A

An account of the thermal structure of the upper atmosphere in the range from 120 km to about 1000 km and its key feature, the diurnal variation, is presented. Five effects examined were: the diurnal variation (atmospheric bulge), the solar activity effect (27-day variation), solar cycle effect (11-year variation), the geomagnetic activity effect, and the semiannual variation. The drag-induced acceleration of Injun III was used to determine the atmospheric density at an altitude of 250 km for the time from December 15, 1962 through June 29, 1963. Results obtained from Echo 2 were used to study the semiannual variation. S.P.

N68-10853 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, AUGUST 1967 [IONOSHAERENDATA, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, AUGUST 1967]
Aug. 1967 44 p In GERMAN and ENGLISH
(Rept.-254-F)

Data are given on ionospheric measurements in Germany during August, 1967. Ionospheric characteristic punch card codes contain the frequencies for the F and E layers and their stratifications. Transl. by G.G.

N68-10885# Mitre Corp., Bedford, Mass.
A SEISMIC CLASSIFICATION MODEL
Jack W. Clark Sep. 1967 56 p refs
(Contract AF 19(628)-5165; ARPA Order 800)
(MTR-305; ESD-TR-67-75; AD-659161)

The report is intended as an introduction to one possible approach to the seismic classification problem. It develops a very general classification model using automatic non-parametric learning based on limited data of known classification. The model accepts discriminants extracted from the seismogram and yields the probability that the input was due to an earthquake or an explosion. Thus, the discriminants are assumed to be available as inputs. Pattern recognition as used here is defined, the classification procedure is outlined, the adaptive estimation of joint probability-densities from a finite number of multi-dimensional vectors of known classification (the learning model) is discussed, a simplified flow diagram of the learning model is presented, and the selection of necessary control parameters is investigated. Author (TAB)

N68-10976*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BEHAVIOR OF THE TOPSIDE IONOSPHERE DURING A GREAT MAGNETIC STORM
S. J. Bauer and B. V. Krishnamurthy Nov. 1967 29 p refs
(NASA-TM-X-63034; X-615-67-576) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Variations in the electron density distribution of the topside ionosphere (including the height of the F_2 peak) obtained from Alouette I during the great magnetic storm of 17–18 April 1965 are analyzed. Both, enhancement and depletion of topside ionization are observed depending on the phase of the magnetic storm. Specifically, enhancement is associated with the positive phase and the asymmetric part of the main phase, while depletion of the topside ionosphere occurs during the symmetric part of the storm main phase over a latitude range corresponding to L values greater than 3. Associated with this depletion is a redistribution of ionization indicating that the topside ionosphere during the symmetric main phase consists primarily of O^+ (with H^+ being depleted).

The enhancement of topside ionization during the positive phase of the storm appears to be associated with the compression of the daytime magnetosphere during that phase of the storm. The depletion seems to be associated with the expansion of field tubes due to the presence of the high energy-density ring current plasma as observed on satellites causing an upward flux from the topside ionosphere. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-10001* Infrared Industries, Inc., Santa Barbara, Calif.
TEMPERATURE MEASUREMENT SYSTEM Final Report, 7 Jun.–7 Aug. 1967
14 Aug. 1967 108 p
(Contract NAS5-10412)
(NASA-CR-89988) CFSTI: $3.00 CSCL 14B

Design of a temperature measurement system utilizing infrared radiation sensing techniques is reported. The system will measure the temperature profile of a low-level, hot gas thrustor during operation in a vacuum chamber. The output, a voltage analogous to the temperature, is synchronized with the instantaneous pointing direction of the radiometer. The temperature profile is also displayed on photographic film wherein the shades of gray correspond to the temperature levels. Author

N68-10015# Oak Ridge National Lab., Tenn. Gaseous Diffusion Plant.
MODIFIED LIQUID CHROMATOGRAPHY MONITORING SYSTEM OPERATING AND MAINTENANCE MANUAL
R. H. Stevens, H. A. Kermicle, comp., and R. C. Smith, comp. 5 Jul. 1967 33 p ref
(Contract W-7405-ENG-26)
(K-L-6157) CFSTI: HC $3.00/MF $0.65

This system will analyze a flowing stream for dissolved organic constituents and is specifically designed to monitor the effluent from liquid–liquid or liquid–solid chromatography columns. The complete monitoring system consists of a modified Barber–Colman Liquid Chromatography Monitor, Model 5400; a low-drift, feedback-type electrometer; and a Honeywell ElectroniK-19 recorder with an added autoranging circuit and event marker. The modifications and additions which were made to the monitor to improve the signal-to-noise ratio and increase the sensitivity and reproductibility are also listed. NSA

N68-10057*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A USEFUL MODIFICATION OF THE WRIGHT SPIROMETER
James Roman and Robert N. Sato Washington NASA Nov. 1967 13 p ref
(NASA-TN-D-4234) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The Wright spirometer is a gas flowmeter for physiological use which is small and reliable. However, data collected with this device must be reduced manually, and the calibration curve is nonlinear at low flow values. The instrument was modified by fitting the output shaft with a spoked wheel that interrupts the light beam between a low-power light source and a photonsensor. This modification provides a digital electrical output that can be computer-reduced, permitting correction of the data for the nonlinearity of the calibration curve. The power drain is 96 milliwatts, which is small enough to be drawn from the battery supplies of most self-contained miniature tape recorders. Author

N68-10163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A HIGH-SPEED SELECTIVE RECORDING SYSTEM (HSSRS)
Norman S. Babbitt Sep. 1967 31 p refs
(NASA-TM-X-55991; X-324-67-461) CFSTI: HC $3.00/MF $0.65 CSCL 14D

Many environmental test laboratories use a centralized automatic data-handling system for collecting and processing the large volume of specimen and facility data generated during test operations. Use of such a system involves an inherent difficulty in efficiently selecting specific channels of data for processing without using an on-line computer. This restriction was encountered in the data-collection system (DCS) used at the Goddard Space Flight Center for evaluating the performance of spacecraft in simulated environments. The high-speed selective recording system was designed and installed to overcome this difficulty. It provides the capability of acquiring selected data in a block-gap format from any number of data points available in the DCS. No computer is required. The acquired data are synchronous with the DCS and programmable, and are permanently recorded on magnetic tape for subsequent processing. Author

N68-10201# Virginia Univ., Charlottesville. Industrial Research and Development Center.
THE POST MIXER SPECTRA OF FREQUENCY MODULATED DISTANCE MEASURING SYSTEMS Final Report
G. A. McAlpine, J. F. Dammann, J. H. Highfill, and J. C. Isaacs Sep. 1967 149 p refs
(Contract DA-49-186-AMC-315(D))
(IRDC-3358-122-67U; AD-659470)

Two techniques for the determination of post mixer spectra of FM distance measuring systems are presented and discussed: (1) For periodic frequency modulation the post mixer signal is modeled explicitly on a digital computer and the spectrum computed using a fast and accurate (better than 1%) Fourier transform technique and averaging in the frequency domain; (2) An analytic approach was developed, using the method of conditional expectations, for the determination of the covariance function of the post mixer signal which should be particularly useful for some types of non-Gaussian random modulation. To provide a check on the formal methodology the analytical approach was specialized to the case of periodic symmetrical linear sweep FM and the resulting spectra compared to those obtained using the independently developed computer programs. Author (TAB)

N68-10218# California Univ., Berkeley. Lawrence Radiation Lab.
RECORDING, ANALYZING, AND REPRESENTING LARGE-SCALE DIGITAL MEASUREMENTS OF MAGNETIC FIELD
Donald H. Nelson 29 Jun. 1967 8 p refs Presented at the 2nd Intern. Conf. on Magnet Technol., Oxford
(Contract W-7405-ENG-48)
(UCRL-17641; CONF-670705-10) CFSTI: HC $3.00/MF $0.65

The continuous demand for large-scale high-precision magnetic field measurements at Lawrence Radiation Laboratory has resulted in the development of streamlined data-handling procedures and data-processing programs. These procedures and computer programs have been developed during the course of processing about 5,000,000 magnetic field measurements in the past four years. Techniques are presented which are valid regardless of the

data-acquisition system employed. However, examples are drawn from experience with the Lawrence Radiation Laboratory Rapid Mapper Magnet-Measuring system, which has been successful largely because it was designed with these techniques in mind. The Rapid Mapper's standard recording sequences and computer programs for detecting and correcting errors, normalizing the data, comparing sets of data, and producing graphs and contour plots are described. Author (NSA)

N68-10243# Naval Ordnance Lab., White Oak, Md.
ANALOG SHOCK-SPECTRUM ANALYZER
William W. Mebane 12 Jun. 1967 19 p refs
(NOLTR-67-97; AD-659290)

The report describes a low-cost, compact analog shock-spectrum analyzer that was designed and built at NOL(WO). A brief background and typical operational procedures are given. Electrical parameters and design details are discussed. Comparison of theoretical and experimental results indicates a system accuracy of better than plus or minus 5%. Author (TAB)

N68-10244# Naval Ship Research and Development Center, Washington, D. C. Marine Engineering Lab.
DEVELOPMENT OF A SELF-COOLED LOW-PRESSURE GAS FROST-POINT INDICATOR
Richard J. Jones Oct. 1967 21 p refs
(NSRDC-2461; AD-659291)

The development of a self-cooled low-pressure (up to 150 pounds per square inch) moisture indicator is described. Laboratory tests indicate that the instrument is accurate to within 2-3 F dew/frost point temperature when compared to standards and has response and performance characteristics making it suitable for shipboard service as an intermittent monitoring instrument. Development of the instrument is continuing in the area of automatic equipment for sensing the dew or frost point. Author (TAB)

N68-10246# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SENSOR OF RATIOS OF ABSOLUTE GAS PRESSURES [DATCHIK SOOTNOSHENIYA ABSOLYUTNYKH DAVLENIY GAZA]
G. I. Tyukal' and L. A. Pletnev 27 Feb. 1967 6 p Transl. into ENGLISH from Russian Patent no. 131525 (Appl. no. 651159/26, 18 Jan. 1960) 2 p
(FTD-HT-67-23; AD-659665)

The article describes a sensor of ratios of absolute gas pressures containing elastic sensitive elements picking up pressures and acting on a compensation spring system transmitting the force onto a tensometric converter which for the purpose of improving the dependability and precision of operation of the sensor and the possibility of checking in under barometric pressure, there is used a supplementary correcting lever which takes into account the imbalance of the effective areas of the elastic sensitive elements and an eccentric (cam) for controlling the lever, the cam acting on the latters presmatic support. Author (TAB)

N68-10268*# Michigan Univ., Ann Arbor. Infrared and Optical Sensor Lab.
INVESTIGATION OF SPECTRUM-MATCHING SENSING IN AGRICULTURE, VOLUME I Semiannual Report, Dec. 1, 1965–Sep. 30, 1966
Fabian C. Polcyn Sep. 1967 126 p refs
(Grant NsG-715)
(NASA-CR-89993) CFSTI: HC $3.00/MF $0.65 CSCL 14E

A spectrum-matching imaging system for agricultural survey purposes is being evaluated. A 12-channel spectrometer for the visible region was combined with an optical–mechanical scanner to obtain calibrated simultaneous multispectral data in the same electronic format so that real-time automatic recognition processes might be used. Multispectral data in 18 channels from the 0.3- to 15-μ region have been obtained with a combination of two scanners mounted in a C-47 aircraft. The research data are tape recorded to facilitate the development of spectrum-matching schemes and to permit subsequent extraction of the signatures of vegetation types of interest. Analysis of data collected in 1964 over agricultural sites has shown the non-Lambertian reflection characteristics of different crop species and the importance of the scanner calibration techniques for current data-acquisition programs. Statistical variations of crop signatures and the effects of reflectance geometry and instrumental parameters on the reliability of a spectrum-matching system are being investigated. Author

N68-10286*# Honeywell, Inc., Minneapolis, Minn.
A STUDY OF ALL-FLUID, HIGH-TEMPERATURE-SENSING PROBES
R. G. Bailey, L. L. Sherwood, K. E. Solle, J. B. Starr, E. G. Zoerb Apr. 1967 111 p
(Contract NAS7-412)
(NASA-CR-90092; Honeywell-12023-FR1) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A fluid oscillator temperature sensor concept was applied in developing miniaturized temperature sensing probes for general use in hypersonic wind tunnels and similar hot gas measuring facilities. Material evaluation and fabrication studies were conducted, and a chrome composite material was chosen which could withstand temperatures of 3500°R in an oxidizing environment. Probes constructed of Inconel 702 were usable to 2200°R. The development of suitable readout schemes and the solution to low inlet pressure noise problems are discussed. The probe uses the propagation velocity of an acoustic signal in a small cavity to cause oscillatory pressure fluctuations which are related in frequency to the temperature of the operating gas. The time response of the instrument is dependent upon the purging time of the fluid within the sensor cavities and the heating rate of the body material. Test results indicate that the all-fluid temperature probe can be used to measure total temperature distribution in hypersonic flow fields. M.G.J.

N68-10348*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
DESIGN FOR ORIENTATION OF BALLOON-BORNE EQUIPMENT
Gerald A. Anderson Jun. 1967 19 p
(Contract 5C24-005-050(122); Nonr-710(60))
(NASA-CR-90083; CR-96; AD-658529) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Presents the design of a system to orientate a balloon-borne instrument package about a vertical axis. Pointing accuracy obtained is plus or minus 1.5 degrees. An independent photographic recording system measures the azimuth angle with respect to the star Polaris to plus or minus 0.1 degrees. The instrument package is rotated against a light weight reaction wheel which is designed for maximum moment of inertia. A pulse-width modulation system is used to drive the orientation motor. A fluxgate magnetometer, used for the sensor element, causes the instrument package to be orientated with respect to the horizontal component of the earths field. The instrument, a gamma-ray telescope, is oriented in the north-south plane and is tilted at an angle with the vertical which will correspond with the elevation of the suspected gamma-ray source when the source crosses the local meridian. Author (TAB)

N68-10363# California Univ., Berkeley. Lawrence Radiation Lab.
DESIGN AND PERFORMANCE OF A HIGH-RESOLUTION HIGH-RATE AMPLIFIER SYSTEM FOR NUCLEAR SPECTROMETRY

F. S. Goulding, D. A. Landis, and R. H. Pehl May 1967 27 p refs Presented at the Conf. on Semicond. Nucl. Particle Detectors and Circuits, Gatlinburg, Tenn., May 1967
(Contract W-7405-ENG-48)
(UCRL-17560; CONF-670520-9) CFSTI: HC $3.00/MF $0.65

A brief outline of a high-resolution high-rate amplifier system for gamma spectroscopy is presented, and some of the results achieved are discussed. The system described allows counting rates more than 10 times as high as previously with virtually no sacrifice of energy resolution. NSA

N68-10458# Southwest Research Inst., San Antonio, Tex.
DEVELOPMENT OF SPECIAL PURPOSE CATHETER TIP TRANSDUCERS Final Report, 15 Sep. 1966–15 May 1967
Charles J. Laenger, Ray W. Ware, and Menan C. Hanz Aug. 1967 44 p refs
(Contract F41609-C-0027)
(AD-659165) CFSTI: HC $3.00/MF $0.65

The report summarizes the work done toward the development of ultrasonic Doppler blood flow velocity measurement catheters and multipurpose catheters which included ultrasonic transducers developed during the program. A prototype split-disc type ultrasonic transducer developed previously was used as a basis of design. Five operating ultrasonic catheters, which were thoroughly tested in vitro were delivered for in vivo tests in experimental animals. Three of these transducers were of split-disc construction and two were the solid-disc type with electrically isolated active electrodes. All catheters were operable but their performance characteristics differed. Intravascular blood flow velocity information was acquired at various points within the great vessels with four of the five catheters. One catheter contained a lumen for blood sampling and a stiffener for pre-positioning the tip. Another contained a pressure transducer with which simultaneous blood pressure and blood flow velocity data were acquired. Operating characteristics and as-built drawings were supplied for all catheters. A brief review of the state-of-the-art of catheter tip ultrasonic flowmeters is presented and suggestions for approaches to further development are made. Author (TAB)

N68-10587# Atomics International, Canoga Park, Calif.
SUPERCONDUCTING NUCLEAR PARTICLE DETECTOR Final Report
D. E. Spiel, R. W. Boom, and E. C. Crittenden, Jr. Jul. 1967 87 p refs
(Contract DA-18-035-AMC-107(A))
(AI-67-74; NDL-TR-87; AD-659409)

Work was undertaken to determine the feasibility of using thin superconducting films as nuclear particle detectors. The results of experiments show conclusively that such devices can be used to detect such radiation. The diffusion of energy from electrons excited by charged particle bombardment was studied by observation of superconducting-normal transitions caused by alpha particles incident on thin films of tin or indium. Because the films were sufficiently narrow, alpha particles initiated transitions across the full width. The transitions were observed by means of the IR drop produced by a transport current. For low current densities, self-terminating pulses were observed. For higher current densities, a normal region initiated by an alpha particle spread by boundary propagation to the ends of the film as the result of Joule heating. The films were deposited on 1/8-in.-thick crystalline quartz or glass substrates in a vacuum of the order of 0.000001 torr. Superconducting-normal transitions were observed with the films cooled by a liquid helium bath on the back side of the substrate. A thin Po210 source, suspended in vacuum above the film, supplied 5.3 MeV alphas. Author (TAB)

N68-10624*# Schjeldahl (G. T.) Co., Northfield, Minn.
FINAL REPORT, OCTOBER 21, 1966–FEBRUARY 1, 1967
Donald W. Hanson 1 Feb. 1967 32 p
(Contract NAS5-9689)
(NASA-CR-90098) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A manufacturing procedure has been developed for one breadboard model and one prototype model of an instrument to measure the solar constant. This instrument is described in contract NAS5-9689 in accordance with the attached exhibit "A". The solar constant measuring instrument is a thermal housing that surrounds the Blackbody Temperature Sensor. This housing provides a temperature-stable environment for the Blackbody Sensor. The housing is composed of a heater housing, cool aperture, two thermal housings, and base. Each component is equipped with a special thermal coating designed to stabilize temperature. After the construction and design study of the breadboard model was made, one prototype was manufactured by the described process. Author

N68-10640# Japan Atomic Energy Research Inst., Ibaraki.
A SOLID-STATE ELECTROMETER AND ITS APPLICATION TO β RAY THICKNESS GAGE
Michio Katagiri and Hiro Yamasaki Mar. 1967 14 p refs Transl. into ENGLISH from Radioisotopes (Tokyo), v. 14, no. 4, Jul. 1965 p 293–299 Submitted for publication
(NSJ-TR-83)

An all solid-state pre-amplifier (ionization–current amplifier) for β ray thickness gage was designed and was proved ideal for process automation by the actual applications. The amplifier which is called "Pico-diode electrometer" has the following characteristics. It has no drift (less than 2×10^{-15} amp/°C at $0\approx50$°C) immediately after switching on for almost eternal period in the sensitivity of $10^{-11}\approx10^{-12}$ amp through the input resistor of more than 10^{10} ohm. The circuit is a type of parametric oscillating amplifier which gives high gain and excellent stability with a simple circuit. This new solid state electrometer makes β gage more reliable than ever before on the process application. The principle of the parametric oscillating amplifier, its characteristics, and the system of the β ray thickness gage with the electrometer are described. Author (NSA)

N68-10647* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE APPLICATIONS TECHNOLOGY SATELLITE IMAGE DISSECTOR CAMERA EXPERIMENT
G. A. Branchflower, R. H. Foote, and D. Figgins Washington NASA Nov. 1967 15 p
(NASA-TN-D-4186) CFSTI: $3.00 CSCL 14E

The image dissector camera experiment, which is scheduled to fly aboard the Applications Technology Satellite-C, is described. Camera system parameters are presented and a description of system operation, including the clock synchronizer and timing and control logic, is given. Ground support equipment is also discussed. Author

N68-10652# Japan Broadcasting Corp., Tokyo. Technical Research Labs.
RECENT DEVELOPMENTS OF COLOR TELEVISION CAMERAS AT NHK
Kazuo Hayashi and Kozo Hayashi Sep. 1967 13 p *Its* Ser. No. 113

The contrast ratio of the picture shown on the screen of the color receiver is usually between 20:1 and 30:1. This is smaller than that of the originating scene. Therefore, the contrast ratio of the picture must be compressed without sacrificing the reproduction of even a slight tonal difference in televised objects. In this respect, image orthicon-type tubes are superior to vidicon-type tubes. The former shows knee characteristics and edge effects similar to the lateral adaptation effects of the human eye in their transfer characteristics. Where separate luminance systems are

concerned, a luminance channel image orthicon tube can be operated in a manner similar to a black-and-white camera. The effects mentioned above are more easily obtained than in the three-tube camera system. At the same time compatibility for black-and-white picture reproduction is improved. At NHK, a color camera system has been studied and developed according to the principles just defined. At the present time the following two points, in addition to picture quality, are viewed as the targets of the developmental work on color camera systems. (1) High sensitivity; (2) Simple operation. In the sections which follow, main color camera systems that were developed and used by NHK are described. Author

N68-10653# Japan Broadcasting Corp., Tokyo. Technical Research Labs.

THE EFFECTS OF LENS FLARE ON PICTURE QUALITY

Sizuo Tatuoka Aug. 1967 11 p *Its* Ser. No. 112

The illuminance distribution of an image formed by a lens does not conform exactly to the luminance distribution of an object for various reasons. There is a progressive reduction in illuminance for off-axis image point as the obliquity of the incident beam is increased. The contrast of fine details in an image formed by a lens is lessened by lens aberrations and diffraction of light. These are treated in detail by the optical transfer (response) function of the lens including the case of defocus. A flare light and ghost images of a lens also disturb the illuminance distribution. They are caused by unnecessary light on the normal image formation. They appear around the images of bright objects, and extend considerably away from them. They are very complicated, and their cases are varied. For these reasons, very few systematic studies have been carried on. Prior to the invention of the reflection reducing coating, more than four-element lenses were little used because of their low transmittance and large amount of flare light due to the internal multiple reflections at the refracting surfaces. For some time after the invention of the coating, flare did not pose a problem since the effect of the reflected light was small. In recent years, however, with the increase of optical systems having large numbers of component elements, such as zoom lens and relay lens system, flares and ghosts have begun to attract attention again. Author

N68-10676 Lockheed Missiles and Space Co., Palo Alto, Calif.

USE OF AN INTERFEROMETER WITH A DIFFRACTION GRATING TO INVESTIGATE FLOW AROUND MODELS IN A SHOCK TUBE

L. A. Vasil'ev, I. V. Ershov, E. V. Sokolenko, and V. I. Ianichkin [1967] 8 p refs Transl. into ENGLISH from Dokl. Adad. Nauk SSSR (Moscow), v. 175, no. 6, Aug. 1967 p 1245–1248

Techniques are discussed for achieving optimum arrangement of an interferometer and diffraction grating to study gas dynamic properties. The gas flow around a wedge model was photographed at different instrument adjustments, for finite and infinite fringe widths. Interferograms for each case are presented. For finite fringe widths, the equal density lines of the gas inhomogeneity at the model are equal displacement of the interference fringes. For infinite fringe widths, the interference fringes themselves are shown to be equal density lines. A photograph of the reverse flow around a cone is also given. E.C.

N68-10690# California Univ., La Jolla. Scripps Institution of Oceanography.

A FLAME PHOTOMETER FOR SMALL AMOUNTS OF CESIUM

T. R. Folsom, C. Sreekumaran, W. E. Weitz, Jr., and D. A. Tennant 16 May 1967 36 p refs

(Contract Nonr-2216 (22))

(SIO-67-20; TR-922-ERG-A-67; AD-659210)

A new photometric system is described that allows measurement of very small traces of an element such as cesium to be determined quantitatively with greater precision than previously possible through study of flame emission spectra. For example, with the new system it was found possible to replicate measurements of the cesium in quantities that are normally present in one liter of sea water (about 0.3 micrograms) with standard error less than 0.5 per cent. Dilute cesium standard solutions can be compared significantly within a few parts per billion. Precise comparison of flame emissions requires precise control of flow of the solution into the flame; therefore, routine washing of aspirators must be done. Therefore, a specialized automatic sample-changing system was developed to provide for precise timing of the burning of the sample and the standard solutions and to carry out aspirator washings immediately following the burning of each sample. Author (TAB)

N68-10693 Royal Aircraft Establishment, Farnborough (England).

PRELIMINARY INVESTIGATIONS INTO HOLOGRAPHY AND ITS APPLICATION TO CHARACTER RECOGNITION

A. C. Merchant, G. E. Keyte, R. Barratt, and G. W. Pearson Jan. 1967 58 p refs

(TR-67031)

The progress on the holographic technique is outlined. The main purpose of the investigation was to gain familiarity with the practical details of the process, but to give direction to the work, one specific application, that to pattern recognition, was selected for particular study. A series of appendices give a brief account of the theory behind each of the experiments described. Author

N68-10713# Japan Atomic Energy Research Inst., Ibaraki.

SEQUENTIAL DELAY SAMPLING TIME ANALYZER

Hirotaka Sasaki Mar. 1967 12 p refs Transl. into ENGLISH from Oyo Butsuri (Tokyo), v. 35, no. 1, Jan. 1966 p 34–40 Submitted for publication

(NSJ-TR-79)

For improvement of accuracy of measurement by the pulsed neutron method in nuclear reactor physics, a sequentially delayed sampling time analyzer was developed. The analyzer has 256 channels with a minimum channel width of 0.1 μ sec; it measures the time variation of the thermal neutron flux by sampling the flux every 15 μsec. The sampling times are made to delay by a 1.6-μsec increment every burst of fast neutrons, whereby an effective sampling rate of 1.6 μsec and measurement of rapid variations of the flux are attained. This device is used as a plug-in unit in connection with a pulse analyzer of 1024-channel, 16-bits/ch magnetic memory cores. In a diffusion test with graphite moderator in a semihomogeneous critical assembly of the Japan Atomic Energy Research Institute, the time resolution of the analyzer was confirmed to be about 10 times that of conventional analyzers. Author (NSA)

N68-10742# Technology, Inc., Dayton, Ohio.

TECHNIQUES AND COMPUTER PROGRAMS TO COMPUTE GRAVITY FROM IN-FLIGHT MAGNETIC TAPE RECORDINGS Final Report, 1 Jul. 1965–30 Jun. 1967

Cyril G. Peckham and Dwight A. Harruff Jun. 1967 120 p

(Contract AF 19(628)-5218))

(AFCRL-67-0522; AD-659451)

Techniques were developed to compute gravitational acceleration from the in-flight measurements recorded by an airborne magnetic tape recorder. The reduced data were collected during approximately 340 flight lines, in addition to the recorder, the aircraft carried three gravity meters—Lacoste–Romberg, Askania–Graf, and Worden—and the peripheral instruments needed to complement the gravity measurements. Developments included techniques to smooth the output from each of the three gravity meters; to derive and apply corrections such as those for the Eotvos effect and the aircraft's horizontal and vertical acceleration; and to compute an accurate latitude and longitude for each

gravitational acceleration. In addition, computer programs were developed to process the data recorded on either charts or magnetic tape. Author (TAB)

N68-10758# Aeroprojects, Inc., West Chester, Pa.
APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS Bimonthly Progress Report, Jun. 1–Jul. 31, 1967
Aug. 1967 11 p ref
(Contract AT(30-1)-3622)
(NYO-3622-10; BMPR-35) CFSTI: HC $3.00/MF $0.65

Development of ultrasonic instrumentation for incipient boiling detection in liquid metals or fused salts is outlined. Flow rate experiments using an ultrasonic flowmeter are presented. NSA

N68-10780 Japan Atomic Energy Research Inst., Tokyo. Div. of Power Reactor Development.
ANNEMOMETRIC CHARACTERISTICS OF SEMI-CONDUCTOR FLOW-METER
Yoshizo Okamoto and Juichi Hanawa (Ibaraki Univ., Japan) Sep. 1967 17 p refs In JAPANESE; ENGLISH summary
(JAERI-1142)

The annemometric performance has been improved by use of a spherical head in the center of which a thermistor particle is inserted. Stagnation, standard flow, and free flow tests were made, and the relation between the head release and flow velocity was obtained. The results of experiments were expressed by a simple correlation of Nusselt number and Reynolds number. The relation between an inclined angle and the Nu number was also obtained when the channel axis of the head was inclined to the flow direction. Author

N68-10791# Cologne Univ. (West Germany). Inst. for Nuclear Physics.
A PULSE DIVISION CIRCUIT FOR USE WITH POSITION-SENSITIVE DETECTORS [EINE IMPULSDIVISIONSSTUFE FUER ANWENDUNGEN BEI ORTSEMPFINDLICHEN DETEKTOREN]
W. R. Kuhlmann Jul. 1967 16 p refs In GERMAN
(BMwF-FBK-67-61)

For experiments with detectors, which give an analog information about the spot, where the particle has entered the detector, an electronic pulse division circuit was evaluated. The circuit derives an output pulse $U_D \approx \ln |U_1/U_2|$ from two coincident input signals U_1 and U_2. These may vary in a range $1.0 \text{ V} \leq U_2 \leq 10$ V while $|U_1/U_2|$ varies from 1.2 to 4.0. The output pulses may be analyzed directly by a pulse-height-analyser. Author (NSA)

N68-10826# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SERVODRIVE WITH CONTINUOUS CONTROL [VOZMOZHNOST' ISPOL'ZOVANIYA METODA NAKOPLENIYA SLABYKH ELEKTRICHESKIKH SIGNALOV V FOTOELEKTRICHESKIKH SLEDYASHCHIKH SISTEMAKH AVTOMATICHESKOGO GIDIROVANIYA TELESKOPOV]
P. V. Nikolayev, I. P. Rozhnova, and Yu. A. Sabinin 18 Aug. 1967 18 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Inst. Elektromech. (USSR), 1965 p 80–87
(FTD-MT-66-122; TT-67-62989; AD-659273)

The existing photoelectric telescope guidance systems developed in the SSSR and abroad cannot fully satisfy the demands for weak astronomical object tracking. An analysis of the sensitivity of various instruments in operation shows that the automation of medium sized telescopes with optical guides having 150-200 mm apertures demands a reduction in sensitivity threshold of photoguides by 2 to 3 stellar magnitudes. This may be achieved either by developing more sensitive photomultipliers or by applying the method of accumulation of weak electric signals in photosensors. An experimental study was made of the operation of an FEU-64 photomultiplier under conditions close to those found in automatic guide photosensors using half-disk modulators of light flux. The telescope controlled was an AZT-7 device with a 200 mm aperture and a focal length of 10 m. This article presents the theoretical basis for the photomultiplier operation, the design of the setup, and the results of tests showing that the sensitivity threshold can be lowered to the 2.5-3 level of stellar magnitude by the application of the accumulation method. Author (TAB)

N68-10847 Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente.
A SPECTROMETER FOR EXAMINING THE ENERGY DISTRIBUTION OF FAST NEUTRONS [EIN SPEKTROMETER ZUR UNTERSUCHUNG DER ENERGIEVERTEILUNG SCHNELLER NEUTRONEN]
O. Krisch Aug. 1967 52 p refs In GERMAN
(JUL-499-RX) CFSTI: $3.00

Described is the construction of a neutron spectrometer that uses a thin polyethylene membrane to obtain recoil proton scattering and a counting telescope to provide the neutron spectrum. This spectrometer can measure neutron energies from 2 to 20 MeV and possesses a response function of about 10^{-5}. Addition of a 3 mm thick scintillation crystal improves its energy spectrum up to 30 MeV. Transl. by G.G.

N68-10873# Argonne National Lab., Ill.
THE AUTOMATIC EVALUATION OF NUCLEAR TRACK PLATES AND SOLID DETECTOR PLATES [DIE AUTOMATISCHE AUSWERTUNG VON KERNSPUR-UND FESTKORPERDETEKTORPLATTEN]
F. Bitter, G. Fiedler, and H. Wollnik Jul. 1967 9 p refs Transl. into ENGLISH from Nucl. Instr. Methods, v. 51, 1967 p 241–244
(ANL-TRANS-509) CFSTI: HC $3.00/MF $0.65

An orthogonal mechanical scanner is described which makes the time consuming and tedious tasks of visual scanning of nuclear emulsions and solid detector plates in special cases obsolete. With this intrument in about 120 min a plate of 2.5×7.5 cm^2 can be scanned completely in 10 μm wide stripes with a velocity of 2.8 cm/sec. The advantage of this instrument is the electronic pulse-length discrimination which makes it unnecessary to use several photomultipliers and several channels of discriminators. The handling of the instrument as well as the particle identification thus is very much simplified. The instrument is used to scan the mass spectrum of fission particle tracks in nuclear emulsions as well as in solid detectors. Author (NSA)

N68-10875# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
ELECTRICAL DETECTION IN SPARK SOURCE MASS SPECTROGRAPHY
Harry J. Svec and Robert J. Conzemius 19 Jun. 1967 14 p refs Presented at the 4th Intern. Conf. on Mass Spectry., Berlin, 24–29 Sep. 1967
(IS-T-1599; CONF-670920-1) CFSTI: HC $3.00/MF $0.65

An electric detection scheme is described for a spark source mass spectrograph. The ion source and data handling features are discussed. These are noise, interrupted ion beam, fluctuating ion beam, sparking conditions, sample inhomogeneities, duty cycles, energy spread of ion beam, dynamic range, peak identification and resolution, alternate photographic usage, data display, computer orientation, and cost. NSA

N68-10988*# Farnham (Frank C.) Co., Philadelphia, Pa.
PROJECT NIGHT CAMERAS

Washington NASA Nov. 1967 17 p refs Transl. into ENGLISH from the French Report
(Contract NASw-1497)
(NASA-TT-f-11233) CFSTI: $3.00 CSCL 14E

The document consists of a two-part research proposal for extra-atmospheric astronomical observations to be conducted on rockets and satellites. Part I proposes the use of the Veronique-61 rocket to loft stable platforms carrying PUV and UVL cameras (field, 120°×80°; aperture, f/1; objective diameter, 8 mm; recording method, Kodak 103 aO-UV and SC-5 film) to make a complete sky survey of stellar UV sources of magnitude ≤7.5 and weak diffuse light sources (nebulae, interplanetary gas, zodical light, gegenschein). Equipment and control systems specifications, launch and flight parameters, and operating procedures are described in detail. Part II proposes the use of larger cameras of the same type on orbital satellites to map the sky in the UV up to magnitude ≤10. The improved equipment proposed for satellite payload could also photograph the sky in the range 500–1000 Å and perform 3- or 4-color spectrophotometry and diffraction spectrography of stars of magnitude ≤5 with a divergence of 200 Å/mm. Data might be recovered by TV telemetry, but a recoverable photographic record is preferable. Preliminary equipment specifications, flight parameters, and operating procedures are given. Author

N68-10996 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THERMOLUMINESCENCE MEASUREMENT APPARATUS [COMPLESSO PER MISURE DI TERMOLUMINESCENZA]
M. Arabia, G. Caserta, and F. Fioroni 1967 21 p refs In ITALIAN; ENGLISH summary
(RT/EL(67)3)

An equipment designed to measure thermoluminescence on organic and inorganic materials is here described. The assembly can be used to irradiate samples at the liquid nitrogen temperature to warm up it, subsequently, at a constant rate, until +100°C, to analyze and record the light emitted from the sample during warming up. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-10044# Chantiers de l'Atlantique Saint-Nazaire (France).
APPLICATION OF THE MOLTEN FLUX PROCESS TO THE WELDING OF VERY THICK PLATES Quarterly Report, Jan. 3–Mar. 31, 1966
1 Apr. 1966 9 p Transl into ENGLISH from French
(EURAEC-1609; EUR-2822; QR-4) CFSTI: HC $3.00/MF $0.65

The steels studied, austenitic grain evolution during application of the thermal cycle, austenitization studies, dilatometry, and relaxation tests are discussed. NSA

N68-10078*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FABRICATION AND CHARACTERIZATION OF HOT-PRESSED TANTALUM CARBIDE
M. H. Leipold and P. F. Becher 1 Oct. 1967 13 p refs
(Contract NAS7-100)
(NASA-CR-90036; JPL-TR-32-1204) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The microstructure and chemistry of a series of compacts of tantalum carbide hot-pressed from several commerically available powders were studied. Variations in behavior of the powders were observed during hot-pressing. These variations did not correlate with measured characteristics of the material. Densification did not appear to be a diffusion-controlled process; some evidence points to plastic deformation as a possible controlling process. Grain growth rates during pressing were 42 or 165 kcal/g mole, depending on the source of powder. The difference was not explained. An impurity grain boundary phase of Ta_2O_5 was observed as were variations in the tantalum/carbon ratio within a given compact. Author

N68-10120*# Martin Co., Baltimore, Md.
PARTS AND MATERIALS APPLICATION REVIEW FOR SPACE SYSTEMS
J. P. Craig et al Washington NASA 1967 58 p refs Prepared for NASA
(NASA-SP-6505) CFSTI: HC $3.00/MF $0.65 CSCL 14A

Parts and materials application–review activity for project management of space systems is defined, and a guide for performance of effective reviews by parts and materials specialists and design engineers is provided. Parts application review is necessary with regard to: flammability and outgassing properties of parts; compatibility of leads with metal joining processes; compatibility of parts surfaces with coating and encapsulants; and environmental resistance and physical and electrical properties of coatings, encapsulants, and insulating materials. A method for selecting the scope of review activities appropriate to various levels of project requirements is illustrated by examples of projects and their hardware. S.P.

N68-10131*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
REVIEW OF NONDESTRUCTIVE TESTING TECHNIQUES FOR DETECTING LACK OF PENETRATION IN ALUMINUM FUSION WELDS
John A. Gibson (Battelle Mem. Inst.) Redstone Arsenal, Ala. Redstone Sci. Inform. Center Oct. 1967 21 p refs Prepared jointly with Army Missile Command
(Contract DAAH01-67-C-1921)
(NASA-TM-X-60590; RSIC-701) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A literature search was made to determine the effectiveness of various nondestructive testing techniques for detecting lack of penetration, i.e., incomplete penetration, in butt joints in aluminum alloys fusion welded from both sides. Under certain conditions, conventional ultrasonic and radiographic techniques may fail to detect such incomplete penetration. Two approaches to radiographic inspection also are reviewed which might be developed into satisfactory inspection techniques for improving reliability in detection of incomplete joint penetration. One approach involves the measurement of radiographic density variations in weld areas. The other approach involves creating a readily detectable flaw which is completely removed when joint penetration is complete. In addition, two approaches to improve ultrasonic inspection are reviewed. One approach is to increase the sensitivity of the test method by increasing the test frequency. The other approach involves creating a readily detectable flaw which is completely removed when complete penetration is obtained, a similar approach to that proposed for radiographic inspection. Recommendations are made for future research to develop the potential of these approaches. Author

N68-10138* SKF Industries, Inc., King of Prussia, Pa. Research Lab.
EXTREME TEMPERATURE AEROSPACE BEARING LUBRICATION SYSTEMS Final Report

L. A. Peacock and L. B. Sibley 20 Jul. 1967 55 p refs
(Contract NAS3-7912)
(NASA-CR-72322; AL67T072) CSCL 13I

Angular contact steel ball bearings were tested at 600°F, 43,000 rpm, and 459 lbs thrust load with a hydrocarbon lubricant using a low oxygen environment. Out of 30 such bearings, one bearing per test failed by spalling fatigue of the races or balls in five tests, and in a sixth test one bearing failed by smearing at lives up to twice the AFBMA-computed L_{10} life. The estimated L_{10} life of the bearings counting both spalling and smearing failures is about equal to the AFBMA-computed L_{10}, indicating adequate high temperature design life. However, all bearings showed higher lubrication distress in the ball-race tracks than previously tested steel bearings. To observe vibrations at failure, three tests of six unfailed bearings from the above group were continued, but at higher temperatures and loads. Bearing spalling fatigue failures occurred only after the bearing temperatures increased to levels from 670 to 750°F, and the load increased to 900 lbs. The estimated L_{10} life for these failures is twice the AFBMA-computed L_{10}, indicating satisfactory performance. Author

N68-10156# Western Electric Co., Inc., Baltimore, Md. Point Breeze Works.
AUTOGENOUS EXTRUSION
A. N. Gray [1966] 10 p
(AD-656387)

The article discusses the extrusion of plastic without external aid in the form of heating or cooling the extruder during operation. TAB

N68-10172* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTAL STUDY OF THE DYNAMIC CHARACTERISTICS OF TURBOPUMPS
Hideo Ohashi [1967] 65 p refs
(NASA-TM-X-53659) CFSTI: $3.00 CSCL 13K

The characteristics curve of a turbopump defines the relation between the pressure rise and the flow rate when the pump operates steadily with a constant flow rate. In the case in which the flow rate fluctuates rapidly, the pressure rise cannot respond quickly enough to follow along the steady-state characteristics curve, thus resulting in a considerable change of dynamic characteristics. In this study, the response of the pressure rise of a centrifugal pump was experimentally determined when the flow rate fluctuated sinusoidally around its mean value. The experiment showed that the amplitude of pressure rise fluctuation decreased and the phase lag of pressure rise fluctuation increased when the fluctuating frequency exceeded a limiting frequency. The amplitude attenuation and the phase lag of pressure rise fluctuation were larger than the analytical calculation predicted. Author

N68-10234* Aerojet-General Corp., El Monte, Calif. Space-General Plant.
EVALUATION AND DEVELOPMENT OF METAL IMPREGNATED FABRIC Final Technical Report
J. A. Wrede Nov. 1967 50 p refs
(Contract NAS9-7253)
(NASA-CR-65801; SG-1236FR) CSCL 13H

The results are presented of a study which experimentally demonstrated that an efficient, abrasive resistant, flexible, flame resistant structure can be fabricated from metallic fabric, sealed with elastomers, which is suitable for an advanced space suit design for astronauts. A unique spot welding method was developed for joining the metal fabric. The resulting highly flexible structural joints have tensile efficiencies in excess of 85% as demonstrated on the assembly and testing of ultrafine filament nickel-chromium fabrics for high temperature pressure stabilized structures. The structures were exposed to radiation equilibrium surface temperatures of 5000°F and fabric substrate temperatures of 1000°F without leakage under high pressures and combined stresses. The fabric also showed excellent abrasion resistance, resistance to degradation from repeated flexing, and non-toxic flame resistance in a 100% oxygen atmosphere. R.N.A.

N68-10269# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
INJECTION MOLDING OF ELASTOMERS
James D. Ruby Jun. 1967 23 p
(RIA-67-1677; AD-659349)

The injection molding process for elastomers was investigated for its applicability in the fabrication of end items for Army use. A variety of elastomeric compounds was prepared and injection molded. Results indicate that most compounds which can be compression molded can also be injection molded. Rubber items having equivalent physical properties and dimensions were obtained from the two molding processes. Injection molding reduces the time required for curing; eliminates the need to preform the rubber prior to molding; reduces the amount of mold handling; and lowers the rejection rate in comparison with compression molding. Author (TAB)

N68-10279* Advanced Kinetics, Inc., Costa Mesa, Calif.
MAGNETIC FORMING STUDIES
18 Oct. 1967 139 p refs
(Contract NAS8-21029)
(NASA-CR-90038) CSCL 13H

To measure the dynamic stress–strain relationship under high stress–high strain rate conditions, experiments were conducted on straight wire samples stressed uniaxially by magnetically accelerated anvils while being securely attached between a movable anvil and a static block. An elastodynamics approach is taken. The results show that the mechanical properties of a material are functions of the rate at which the material is undergoing strain. An initial large increase in stress over the static case was found; then the material yields, followed by a dip in the curve indicating the onset of plastic deformation. To define the elastodynamic behavior of materials stressed by purely electromagnetic forces, measurements were made on two-dimensional wire hoops stressed radially outward by a transiently-induced Lorentz force. Consideration is given to the theory that the magnetomotive force upon the loop is the vector cross-product of the induced current density through the loop and the magnetic field. The results indicate the importance of the dynamic approach. M.G.J.

N68-10329* Technidyne, Inc., West Chester, Pa.
ULTRASONIC WRENCH FOR FLARED TUBING CONNECTIONS
N. Maropis and F. R. Meyer Sep. 1967 92 p refs
(Contract NAS8-11965)
(NASA-CR-89965) CSCL 13I

Manual and semi-automatic ultrasonic wrenches for tightening flared tubing connections for tubing sizes ranging from 0.318-centimeter (0.125-inch) to 2.54-centimeter (1.0 inch) diameter were designed and fabricated. Ultrasonic activation of the wrench head during torquing increased the percentage of leaktight assemblies of 6061-T6 aluminum alloy components by an average of 73 percent and of CRES 304 stainless steel components by 26 percent, without increasing the applied torque. The ultrasonically assisted torque increased the rotation of the nut by an average of about 14 degrees, increased the measured tensile strains in the nuts, produced higher sealing stresses on the tube flares, and necessitated increased breakaway torque to loosen the assemblies. A modified ultrasonic wrench design of lighter weight construction and lower manufacturing costs was proposed, and the fabrication of two wrench sizes for the flared tubing size range of interest was recommended. Author

N68-10344*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTEGRATION OF NASA-SPONSORED STUDIES ON ALUMINUM WELDING
Koichi Masubuchi (Battelle Mem. Inst.) Redstone Arsenal, Ala. Redstone Sci. Inform. Center Sep. 1967 170 p refs Prepared jointly with Army Missile Command
(Contract DA-01-021-AMC-14693(Z))
(NASA-TM-X-60591; RSIC-670) CFSTI: HC $3.00/MF $0.65 CSCL 13H

This report analyzes and integrates the findings of studies on the welding of aluminum alloys. The following subjects are discussed: (1) effects of shielding-gas contamination on porosity; (2) effects of base- and filler-metal contamination on porosity; (3) mechanisms of porosity formation; (4) scavenger elements to reduce porosity; (5) effects of porosity on weld-joint performance; (6) time–temperature effects and control; (7) transferability of welding parameters in the gas tungsten-arc process; (8) development of arc shaper and puddle stirrer; and (9) material preparation. Major findings obtained in the nine programs on welding aluminum are described, analyzed, and integrated. Recommendations are presented for future work and for application of the integrated findings to the fabrication of structural components of Saturn V rockets. Author

N68-10402*# Midwest Research Inst., Kansas City, Mo.
ADVANCED VALVE TECHNOLOGY, A SURVEY
Louis C. Burmeister, John B. Loser, and Eldon C. Sneegas Washington NASA 1967 190 p refs Revised
(NASA-SP-5019) GPO: $1.00 CSCL 13K

The purpose of this book is to disseminate advanced valve technology throughout all branches of industry. To achieve this objective, it was necessary to (1) determine the present industrial state-of-the-art—this was accomplished by conducting interviews, a literature search, and discussions with application and systems engineers at NASA installations; (2) recognize new advances—valves which have qualified for newer missiles, advanced aircraft, and spacecraft usually represent improvements beyond the industrial state-of-the-art; and (3) report the new technology—when a considerable number of custom-made valves fall within a given category, the combined technology information in that category will often fall into a pattern and indicate new trends and approaches. New trends and techniques mentioned are concerned with leakage, materials, compatibility, contamination, wear, reliability, response time, repeatability, valve actuators, proportional flow control, heat transfer, high pressure and temperature, pressure surge protection, flutter and chatter, and unique designs and applications. R.W.H.

N68-10418*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ATTACHMENT METHODS FOR ADVANCED SPACECRAFT THERMAL CONTROL MATERIALS: AN ANNOTATED BIBLIOGRAPHY, PHASE 1 Summary Report Supplement
Helen M. Abbott and Norbert H. Kordsmeier, Jr. Sep. 1967 120 p refs
(Contract NAS2-4252)
(NASA-CR-73150; LMSC-A908107/SB67-3) CFSTI: HC $3.00/MF $0.65 CSCL 13H

This bibliography includes abstracts from published papers and reports which relate to thermal design parameters as well as attachment techniques for the two thermal control materials. It is anticipated that this compilation will be of assistance to systems and thermal designers. The analysis of candidate attachment techniques in relation to their applicability to a specific design, operating in the 200° to 700°K temperature range are given in the Phase I Summary Report. Author

N68-10480# Instituto Politechnico Nacional, Mexico City. Escuela Superior de Ingenieria Quimica e Industrias Extractivas.
URANIUM DIOXIDE CERAMIC FUELS FOR NUCLEAR REACTORS IN MEXICO [COMBUSTIBLES CERAMICOS DE DIOXIDO DE URANIO PARAREACTORES NUCLEARES EN MEXICO]
Josue Castillo Molina 1968 112 p refs In SPANISH
(NP-16745)

The fabrication of UO_2 tablets for nuclear reactors was studied. Each of the steps in the fabrication, beginning with UO_2, was investigated in detail and the variables in different steps were analyzed to determine their effect on the final product. A procedure for the fabrication of satisfactory tablets was proposed. NSA

N68-10503* General Electric Co., Cincinnati, Ohio. Missile and Space Div.
DESIGN OF TWO ELECTROMAGNETIC PUMPS
G. E. Diedrich and J. W. Gahan Washington NASA Nov. 1967 103 p refs
(Contract NAS3-8500)
(NASA-CR-911) CSCL 13K

A design study program to determine three specific EM pump designs for possible use as boiler feed pumps in Rankine-cycle space electric power systems is described. The three designs were: (1) 9 lb/sec, 240 psi pump for 1000°F potassium using a T-111 duct; (2) 9 lb/sec, 240 psi pump for 1000°F potassium using a 316 SS duct; and (3) 3.25 lb/sec, 240 psi pump for 1000°F potassium using a T-111 duct. A specific design for each of these ratings is described in detail. Complete calculated performance and evaluation for each design are also presented. Final design selection for each rating was based on efficiency, reliability, weight, and fabricability. In general, efficiency was optimized. Author

N68-10511# Office of Aerospace Research, Washington, D. C.
AIR FORCE BASIC RESEARCH IN HIGH-PERFORMANCE FILAMENTARY COMPOSITES
John A. Rolston (Owens-Corning Fiberglas Corp., Granville, Ohio) Sep. 1967 11 p refs *Its* Monographs No. 4
(OAR-67-0010; AD-659374)

Filament-reinforced composites consist of fibers and a matrix working together in combined action to achieve high strength, temperature resistance, or other useful properties. The strength of the composite is controlled primarily by the filament strength which theoretically may approach 10% of the elastic modulus. Materials with properties of interest include boron, aluminum oxide, and graphite. Mono-crystalline whisker technology began in 1952 and has extended to include a number of elements and compounds. Much basic knowledge is needed for growth techniques, structural perfection control, and reliable means of testing. Air Force research in high-performance, fibrous composites covers basic and exploratory research through contracts from OAR, ARL, and ASD. The total work level in composites is low in comparison to work in metallurgy. The greatest need is for a low-cost production method, yielding high strength and long fibers. Other needs include interface research, new matrix materials, studies in micromechanics, and a new academic discipline in composites. Author (TAB)

N68-10573# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF PRACTICE FOR COMPOSITE ROLLING OF STRUCTURAL METAL PANELS Quarterly Report, 16 Nov. 1966–15 Aug. 1967
K. R. Grube, J. R. Van Orsdel, D. N. Williams, and E. S. Bartlett 15 Aug. 1967 16 p
(Contract DA-19-066-AMC-308(X))
(AMMRC-CR-66-02/5; G-7515; QR-5; AD-659429) CFSTI: HC $3.00/MF $0.65

Continued development of practice for composite rolling of structural metal panels was planned. The structural metals are

to include a precipitation-hardening steel (PH 14-8Mo), an alpha-titanium alloy (Ti-4Al-0.202), a beta-titanium alloy (Ti-8Mo-8V-3Al-2Fe), and if preliminary results deem advisable, a high-strength nickel-base alloy (Rene 41). Author (TAB)

N68-10603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A THEORY FOR RAPID DETERMINATION OF RELIABILITY INDICES FOR MACHINE AND INSTRUMENT PARTS [TEORIYA USKORENNOGO OPREDELENIYA POKAZATELEY NADEZHNOSTI DETALEY MASHIN I PRIBOROV]
V. N. Treyer 28 Feb. 1967 7 p refs Transl. into ENGLISH from Akad. Nauk Belorussk. SSR (USSR), v. 9, no. 8, 1965 p 541–543
(FTD-HT-67-30; AD-659667)

Ordinary methods of testing machine and instrument parts for reliability are too time-consuming. A theory is developed for accelerating reliability tests which will give valid results. The theory is based on a distribution law and a hyperbolic law of service life. Samples are tested by step-wise loading until 50% of the objects fail. Meanwhile two other sample lots are tested under constant load. Results are manipulated mathematically to give reliability and service life indexes that can be extended to parts that have not been used. Author (TAB)

N68-10623# Ohio State Univ. Research Foundation, Columbus.
MACHINING VIBRATION RESEARCH Final Report, 12 Oct. 1965–30 Apr. 1967
Donald R. Kibbey, Robert A. Brown, and Marvin Agee May 1967 52 p refs
(Contract DA-19-066-AMC-298(W))
(AD-659547) CFSTI: HC $3.00/MF $0.65

Results of a study of machine tool vibrations are given. A computer-programmed regression analysis is used with multi-variable cutting experiments to show the relative effects on vibration of the machine tool, the workpiece, and other cutting conditions. A system of instrumentation with accelerometers, amplifiers, tape recorder, and spectrum analyzer is described for obtaining spectral vibration data for computer analysis. Certain non-chatter vibrations are shown to be independent of machine tool dynamics. Correlation of vibration with surface finish is discussed. The shortcomings of standard surface finish measurement techniques for obtaining necessary data is demonstrated. Design of an experimental, non-contact, surface finish pickup, based on an electrometer principle is described. Author (TAB)

N68-10792* Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
NONDESTRUCTIVE TESTING FOR SPACE APPLICATIONS: FEASIBILITY AND PRELIMINARY DESIGN STUDY. PART 2: MAINTENANCE AND OPERATION MANUAL FOR PROTOTYPE HARDWARE Final Report
W. A. Zoran [1967] 53 p
(Contract NAS8-20630)
(NASA-CR-90043; SP-67115, Pt. 2) CSCL 13H

This manual describes specific operating and maintenance procedures for a prototype in-space nondestructive test unit. It supplements and modifies manuals covering the Sperry UCD Reflectoscope, Style No. 50C901 and Picker Viso Model 601. Specific inspection procedures are defined for ultrasonic and radiographic inspection of the defect standards established as part of this contract. The sequential inspection procedures are oriented toward the astronaut who will use the unit in the space environment. Author

N68-10798 Toegepast Natuurwetenschappilijk Onderzoek, Delft (Netherlands).
WEAR MEASUREMENTS BY MEANS OF γ-X-FLUORESCENCE
A. Kemper Brussels, EURATOM Oct. 1967 45 p refs
(Contract EURATOM-036-64-7 IRAN)
(EUR-3627.e)

The excitation of X-rays by gamma radiation, so called "γ-X-fluorescence", can be applied to wear measurements by placing, for example, a γ-source plus an X-ray detector on one side of the wearing material and an (non-radioactive) X-ray target inside or on the other side of the wearing material. The attenuation of the characteristic X-rays excited in the target, can be a measure of the (varying) thickness of the wearing layer. The use of radioisotopes is restricted to the time required for the measurements, so the hazards of radiation and contamination are not present. A rubber flooring compound of 1.6 mm thickness has been chosen for the evaluation of the method, since a practical performance trial with this material could be conducted under relatively plain and simple conditions in addition to the laboratory experiments. The procedure in an actual wearing experiment is simple. Targets of silver sheet are applied at interesting points under the flooring tiles and left in position. A measuring probe is placed on the flooring on top of the targets after certain intervals of time depending on the traffic density and the wear rate expected. Then the Ag-KX-signal is registered by single-channel counting. Wear can be assessed by comparing this signal with a calibration graph established in the laboratory. A portable probe containing an Am-241 source and a shielded detector part has been developed. This probe can be operated in connection with commercially available analyzing equipment. Author

N68-10815* Sun Shipbuilding and Dry Dock Co., Chester, Pa. Aero/Hydro Space Div.
STUDY OF WELDING PROCEDURES FOR FABRICATING LARGE STRUCTURES OF 18 PERCENT NICKEL 200 GRADE (VAR) MARAGING STEEL Final Report
Harold Disman Oct. 1967 139 p ref
(Contract NAS3-7965)
(NASA-CR-72333; Doc.-40-40) CFSTI: $3.00 CSCL 13H

A study was conducted to determine methods for welding and locally re-aging aged 18 percent nickel (200) grade VAR maraging steel. Welding techniques were developed for both automatic and manual repair welding. These techniques were demonstrated to produce sound weldments and weld repairs, with properties equal to welds and repairs made in unaged material, in maraged maraging steel. The optimum re-aging cycle was determined for both automatic and repair welds. A segment of the study was directed towards determining the causes and effects of weld defects. The results of this segment of the study were inconclusive due to lack of sufficient variability of past data and difficulty in producing welding defects. Author

N68-10849# Naval Applied Science Lab., Brooklyn, N. Y.
RELIABILITY AND MAINTAINABILITY DATA-SOURCE GUIDE
Jan. 1967 254 p
(AD-659195)

This data-source guide identifies twenty-three Government reliability and maintainability data sources and over ninety-five sources of technical and scientific information for related engineering data. The technical coverage, mission, status, and the address of contacts associated with each data source are summarized in the guide. The guide tabulates responses received from 118 contractors in reply to a questionnaire prepared by ARINC Research. A matrix shows that ninety-four of the 118 had established reliability and maintainability data collection activities. Also presented is a review of the collected data, as to its utility, optimism, currency, and applicability to multicontractor use. Author (TAB)

N68-10906# Iowa State Univ. of Science and Technology, Ames.
REFINING LANTHANUM BY COMBINED ZONE MELTING AND ELECTROTRANSFER PROCESS

V. M. Amonenko, V. S. Pavlov, and A. A. Kruglykh [1968] 6 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, 1966 p 1023–1025
(IS-T-53)

The feasibility of refining by combined zone melting and electrotransfer process was investigated. Specimens, 8 mm in diameter × 120 mm long, were prepared from 99.5%-pure La melted in a vacuum of $3 \cdot 10^{-6}$ mm Hg. The specimens were subjected to zone refining in vacuum with electron-beam heating. Simultaneously, direct current with a density of 4.4 a/mm^2 was passed through the specimens for 70 or 180 hr, depending on the number of passes (5 or 10). It was found that the utmost purification was achieved with 5 passes, after which the impurities content was reduced as follows: Oxygen from 0.080% to 0.032%, N from 0.0047% to 0.0040%, H from 0.0013% to an undetectable quantity, and C from 0.14% to 0.080%. The microhardness dropped from 50 to 30 kg/mm^2. NSA

N68-10952*# Virginia Univ., Charlottesville.
WHIRLING OF THE SINGLE MASS ROTOR
E. J. Gunter, Jr. and D. W. Lewis [1966] 36 p refs
(Contract NAS3-6473; Grants NGR-47-005-050; NsG-682)
(NASA-CR-89961) CFSTI: HC$3.00/MF$0.65 CSCL 13I

The general equations of motion for a single mass, unbalanced rotor on a massless elastic shaft with damping are presented and analyzed for various conditions of synchronous and nonsynchronous precession or whirling. The analysis shows that the introduction of the external damping considerably influences the rotor characteristics and yields results different from those previously reported for the case of no damping. External damping in genral, suppresses certain motions and permits only forward synchronous precession. With light rotor damping, a whirl ratio of 1/3 is predicted when the rotor is operating at three times the rotor critical speed. Author

N68-10953* Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
NONDESTRUCTIVE TESTING FOR SPACE APPLICATIONS: FEASIBILITY AND PRELIMINARY DESIGN STUDY. PART 1: ENVIRONMENTAL TESTING, PROTOTYPE HARDWARE DESIGN, MANUFACTURE, AND EVALUATION Final Report
W. A. Zoran [1967] 69 p
(Contract NAS8-20630)
(NASA-CR-90042; SP-67115, Pt. 1) CSCL 13H

The objectives of this phase of the program were (1) to establish the feasibility of performing ultrasonic and radiographic inspection in the space environment and (2) to design and fabricate an integrated prototype nondestructive test unit to accomplish these functions. Laboratory tests conducted on ultrasonic couplants and transducer materials under vacuum and thermal-vacuum environments indicated that the stable silicone fluids (couplant) and the lead zirconate titanate transducers offer the most potential for unprotected use in space environments. Changes in ultrasonic signal sensitivity with both temperature and pressure however, indicate that these parameters be controlled in actual flight hardware. Electrical modifications to the original equipment (ultrasonic receiver circuits) improved defect resolution and sensitivity in the higher (10mH2) frequency range. Defects established as standards of inspection for early in-space experiments are readily detected using the prototype ultrasonic unit. Laboratory thermal vacuum tests on Polaroid film indicated that the PN55 type film could endure exposure to sub-freezing temperatures and thermal-vacuum of 120°F and 10^{-4} torr without significant degradation of the film image. Hermetically sealing the film in plastic envelopes offered significant additional protection against the environment. Sensitivity tests using the ytterbium 169 radioisotope in the space-modified exposure unit indicated that the required level of sensitivity and definition could be obtained if commercial radiographic film was used; however, a significant sensitivity loss resulted with the use of standard 4×5 commercial grade Polaroid type films. An integrated prototype (breadboard) nondestructive test unit designed to NASA human-engineering standards was fabricated and successfully demonstrated under terrestrial conditions. Accordingly, based upon results of this program, nondestructive testing in-space utilizing ultrasonics and radioisotope (Yb169) radiography is feasible and would make a significant contribution to the space program. Quality assurance of in-space hardware and fabrications, vehicular maintenance, damage assessment and repair, plus medical research and diagnosis are but a few of the areas of immediate potential application. Author

N68-10958* Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
NONDESTRUCTIVE TESTING FOR SPACE APPLICATIONS. FEASIBILITY AND PRELIMINARY DESIGN STUDY. PART 3: PROPOSED FLIGHT HARDWARE PROGRAM Final Report
W. A. Zoran [1967] 21 p
(Contract NAS8-20630)
(NASA-CR-90044; SP-67115, Pt. 3) CSCL 13H

The results of the current program have indicated both a need for and the feasibility of in-space nondestructive testing (NDT). In addition to results of the extensive study effort of this program, a prototype in-space NDT unit has been designed and fabricated. This prototype unit design was oriented toward actual flight hardware. Flight hardware NDT requirements such as human engineering, lift off, and space environment compatability were studied and, as feasible within the scope of the program, incorporated in the prototype unit. The report defines expected problem areas, actual flight hardware requirements, and the scope of a flight hardware program. It also indicates that workable flight hardware NDT equipment can be designed, qualified and fabricated now, but that it is unreasonable to complete in much less than a three year program. Author

N68-10959 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THE PRESSING OF AS RECEIVED URANIUM DIOXIDE POWDERS [SINTERIZZABILITA DELLE POLVERI DI UO_2 STUDIO DELLA PRESSATURA DI POLVERI DI UO_2 AS RECEIVED]
L. Giaquinto, C. Majani, and I. Stamenkovic 1967 29 p refs
(RT/ING(67)6)

The pressure–density dependence for fragile powders was evaluated by a mathematical approach based upon Kawakita empirical relationship. The cold pressing of a number of various uranium dioxide powders was performed in the pressure range from 0.5 to 6.5 t/cm^2. The pressing results were treated by means of several empirical equations without sufficient success. Therefore, upon the agreements with Cooper–Eaton and previously obtained pressure–density dependence, a new interpretation of the pressing mechanism was proposed for fragile powders. The very close relation between green pellet characteristics and sintering kinetics was experimentally demonstrated. Qualitative interdependence of density of sintered powders and surface area of the initial green pellets has been pointed out. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-10049*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APERTURE COUPLING OF A CARBON DIOXIDE LASER EMPLOYING A NEAR–CONFOCAL OPTICAL RESONATOR

John H. McElroy and Harold E. Walker Oct. 1967 13 p refs
(NASA-TM-X-55994; X-524-67-513) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Materials difficulties encountered at the 10.6 micron wavelength of the CO_2 laser often dictate that the laser output be obtained by aperture coupling through a hole in the output mirror. This document presents the results of measurements made on an aperture coupled carbon dioxide laser using a near-confocal optical resonator. The effects of coupling hole diameter and mirror spacing are related to laser multimode power output and mode structure. It is found that odd-symmetric modes dominate and, if a simple mode structure is required, with maximum axial power density, the diameter of the output coupling hole must be restricted. Author

N68-10195 Lockheed Missiles and Space Co., Palo Alto, Calif.
MOMENTUM TRANSFERRED TO A TARGET BY A LASER BEAM
V. N. Rudenko 1967 4 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), no. 4, 1967 p 115–117

The recoil momentum of a torsional pendulum subjected to focused laser radiation was investigated experimentally. A ruby laser was used with two output modes. Results tend to confirm the existence of an optimum radiation intensity which yields a maximum recoil momentum for a given target. E.C.

N68-10399*# Ohio State Univ., Columbus. ElectroScience Lab.
RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS Annual Summary Report, Oct. 1, 1966–Sep. 30, 1967
6 Nov. 1967 9 p refs
(Grant NsG-79-60)
(NASA-CR-90040; Rept.-1093-38) CFSTI: HC $3.00/MF $0.65 CSCL 20E

When two different species of freon gas were made to lase with the addition of helium gas, the resultant spectral output was in the near infrared region. Other studies related to receiver techniques and detectors for use at millimeter and submillimeter wavelengths were concerned with cross sections for and metastable electron removal from argon II, krypton II and neon II gas lasers. Transition probabilities and lifetimes of some $2p^4$–$3p$ excited states of Ne II and $4p^4$–$5p$ excited states of KrII were calculated; and, after deriving the degree of mixing of these excited levels, the direct excitation cross sections to these levels were calculated by the method of sudden perturbation. Because of the greater degree of mixing of the Kr II states, the direct excitation cross section is evenly distributed among all levels with the total angular quantum numbers $J=3/2$ and $1/2$. The vibrational rotational spectrum of AsH_3 in the 5μ region was partially analyzed. M.W.R.

N68-10467*# TRW Systems, Redondo Beach, Calif.
PARTICLE ACCELERATION BY EVAPORATION PRESSURE
R. F. Wuerker Washington NASA Nov. 1967 104 p refs
(Contract NAS9-5113)
(NASA-CR-927; TRW-04848-6001-R0-000) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Accelerating 100 micron sized particles to meteoric velocities of 20 km/sec was studied via focused radiation from a high intensity pulsed solid state laser system. The Q-switched mode gave the highest peak power and permitted operation at the threshold of material yield strength. A computation method developed for computing effective exhaust velocity directly from experimental values of initial mass, final mass, and terminal velocity of the particles was used to predict, via the rocket equation, the ratio of the amount of mass which would have to be ablated to take a given particle from rest to the 20 km/sec velocity. Titanium had an effective exhaust velocity of 4 to 6 km/sec, and from this an initial to final mass ratio of 0.0358 was computed. In other words, 96.4% of the original particles would have to be burned away to bring the remaining mass to the 20 km/sec velocity. Iron had an effective exhaust velocity of 5 km/sec. Although the effective exhaust velocities obtained were not large enough to accelerate matter to terminal velocities of 20 km/sec, the laser ablation approach appeared to be feasible for generating particles with velocities of about 10 km/sec. M.W.R.

N68-10582# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A LASER-DRIVEN IMPLOSION FOR GENERATING VERY HIGH TEMPERATURES
John W. Daiber, Abraham Hertzberg, and Charles E. Wittliff Wright-Patterson AFB, Ohio ARL Jun. 1967 34 p refs
(Contracts AF 33(615)-5389; AF 33(657)-8860)
(ARL-67-0134; AD-659155)

The generation of an implosion for the creation of ultrahigh temperatures using lasers as the energy source is suggested. By using a spherical blast wave to shape the initial density distribution, the laser energy can be preferentially coupled to the periphery of the sphere. An analytical investigation of the implosion in a deuterium–tritium plasma has been made. It was found that above a minimum input energy the thermonuclear energy produced could exceed the laser input energy and the radiative energy loss. Author (TAB)

N68-10812# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
EXPERIMENTAL DETERMINATIONS OF FRINGE COUNTING ERRORS ASSOCIATED WITH ROTATION OF A CORNER CUBE FORMING AN ARM OF LASER INTERFEROMETER
Michael M. McDonnell Jun. 1967 32 p ref
(GIMRADA-RN-26; AD-659333)

Apparatus was constructed and experiments conducted to confirm the effect of corner-cube rotation on the accuracy of linear measurement with an interferometer. Theory was verified within the accuracy of the experiment. These results will serve as guidelines for construction of an optimum transport system for the corner-cube. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-10038# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Quarterly Report, Jan. 1–Mar. 31, 1967
May 1967 15 p refs
(Contract EURATOM-074-65-10-TEEI (RD))
(EURAEC-1864; EUR-3368; QR-6) CFSTI: HC $3.00/MF $0.65

Measurements were made of the tensile properties of irradiated Ferrovac E at different temperatures and strain rates; the range of strain rates is 1.5×10^{-5} to 2×10^{-1} sec^{-1}. Transition temperature measurements were made on Si- and Al-killed ASTM A212 base steels after irradiation and of iron and steel specimens annealed after irradiation (isochronal annealing). Magnetic viscosity studies

were made on Fe–Si 6.5% alloys. Damage dosimetry studies were carried out with measurement of the radioinduced modifications in Ultraperm magnetic properties. These results should be compared with the tensile properties of irradiated Ferrovac E. Author (NSA)

N68-10051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON MICROSCOPY TECHNIQUE FOR DETERMINATION OF DISPERSOID DISTRIBUTION IN POWDER BLENDS
Bruno C. Buzek Washington NASA Nov. 1967 11 p refs
(NASA-TM-X-1468) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The ability to clearly observe and distinguish between oxide and metal particles in a starting powder blend and to determine the initial distribution of the oxide prior to consolidation enables predictions to be made about the final distribution of the oxide particles in a fully consolidated product. A new electron-microscope specimen-preparation technique was developed to aid in making these predictions. This procedure makes it possible to ascertain the size and the degree of agglomeration of the oxide particles, unobstructed by the presence of the metal-matrix particles, before the compaction and sintering of the powder blend. The initial powder blend is envoloped with a thin layer of carbon, and the metal phase is leached out. The retained particles reveal the state of the dispersoid phase after the blending operation. Nickel, tungsten, chromium, and nichrome, each blended with thoria or alumina, were investigated using this technique. A good correlation exists between the dispersoid distribution in the initial blend and the state of agglomeration in the final sintered product. If small oxide particles were well distributed in the initial powder blend, they remained in the final product. If the small oxide particles were clustered in the original powder blend, they appeard as large particles similar in size to the initial clusters after consolidation. Author

N68-10071* California Univ., Los Angeles.
THE MELTING CURVES OF LITHIUM, SODIUM, POTASSIUM AND RUBIDIUM TO 80 KB
H. D. Luedemann and G. C. Kennedy [1967] 25 p refs *Its* Publ. No. 635
(Grant NsG-314)
(NASA-CR-90030) CSCL 11F

The experiments were carried out in modified single-stage piston-cylinder apparatus and the precision of the data is ±2°. Rather sharp changes in the slopes of the melting curves are shown for lithium, potassium, and rubidium at pressures of approximately 60 kB and little change in melting temperature for these substances takes place between 60 and 80 kB. This abrupt flattening of the melting curve may represent maxima in the fusion curves. The curve for sodium is regular and increases to the highest pressure obtained. Within the precision of available experimental data on compression of the alkali metals, melting temperatures of all these alkalis are linear with the volume of the melting solid up to breaks in slopes of the curves at approximately 60 kB, for lithium, potassium, and rubidium. The melting curve of sodium is linear with the volume of the melting solid to 80 kB. The breaks in slopes of the fusion curve probably associated with maxima, in potassium, rubidium, and cesium take place when the solids have undergone a total compression of approximately 35%, whereas the break in slope of the lithium curve takes place at a total compression of approximately 22%. Author

N68-10083# Uppsala Univ. (Sweden). Inst. of Physics.
DISLOCATION MOBILITY AND MULTIPLICATION DURING STRAIN AGEING OF IRON
Y. Bergstroem and O. Vingsbo Apr. 1967 25 p refs
(UUIP-528)

A stress–strain relation was derived for ageing metals. The equation obtained describes the yield-drop phenomenon in terms of dislocation mobility and multiplication in good agreement with experimental stress–strain curves. The effect of strain ageing was introduced into the equation by describing dislocation locking in Cottrell atmospheres by Harper's equation. It was possible to express the increase in upper yield stress as a function of time, and the influence of total dislocation density, impurity content, and temperature was studied for Fe–N alloys. The suggested function describes the ageing process with respect to nitrogen in α-iron in agreement with experimental observations. An attempt was made to describe time-dependent ageing plateaus as the effect of two overlapping ageing processes of different velocities. It is finally suggested that the observed effect of increase in workhardening after strain ageing is the result of a precipitation-induced increase of the friction stress that opposes dislocation glide. Author (NSA)

N68-10085# Uppsala Univ. (Sweden). Inst. of Physics.
CLEAVAGE IN INTRINSIC DISLOCATION DIPOLES IN CUBIC METALS
Olof Vingsbo and Yngve Bergstroem Apr. 1967 35 p refs
(UUIP-529)

The process of cleavage in intrinsic dislocation dipoles was studied for cubic metals. Attention was paid to the anisotropy of cleavage strength, and several dipole geometries were investigated. An expression was derived for normal stress acting on the crystal planes in the dipole, and the cleavage process was suggested to be defined from stress relaxation. Cleavage conditions were derived and investigated with respect to stresses as well as energies. It was found that dipole cleavage is less probable than expected from earlier works. Dipoles of unit Burgers vector cleave only for pure edge orientation in the most brittle (Fe and W) of the investigated metals, and only if the distance between the dislocations is of the same order of magnitude as length of the Burgers vector up to $3d_0$ is a decrease of the influence of dipole orientation of the cleavage properties. Author (NSA)

N68-10086# Uppsala Univ. (Sweden). Inst. of Physics.
APPLICATION OF THE MORSE FUNCTION TO CLEAVAGE
Olof Vingsbo Apr. 1967 20 p refs
(UUIP-527)

A modified Morse function is suggested to describe the cleavage of cubic metals. The function is based on the surface energy of the crystal. This quantity is calculated for a number of cubic metals, using the Morse function parameters derived by Girifalco and Weizer. The suggested function gives an expression for the theoretical cleavage stress, and predicts anisotropic cleavage properties in reasonable agreement with experimental observations. Author (NSA)

N68-10104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF COVER GAS PRESSURES ON ACCELERATED CAVITATION DAMAGE IN SODIUM
Stanley G. Young and James R. Johnston Washington NASA Nov. 1967 24 p refs
(NASA-TN-D-4235) CSCL 11F

An investigation was made to study the effect of pressure on the resistance to cavitation damage of materials under consideration for components of liquid–metal power conversion systems. A vibratory apparatus was used to subject three materials, AISI 316 stainless steel, L-605, and Stellite 6B to accelerated cavitation damage in sodium at 800°F (700°K). Argon cover gas was used to maintain pressures up to 4 atmospheres (4×10^5 N/m^2) during test. Volume loss and volume-loss rate measurements were used to compare the effects of pressure on the degree of damage. Metallographic studies were conducted to determine the nature of damage. Increasing cover-gas pressure significantly increased cavitation damage to all materials for all exposure times. The materials ranked in the same order with respect to resistance

to cavitation damage at all pressures; Stellite 6B was most resistant, L-605 intermediate, and AISI 316 stainless steel least resistant. The steady-state volume-loss rate based on total specimen area increased linearly with cover-gas pressure. When the volume-loss rate data were normalized to include only the heavily damaged area of the specimens, the steady-state volume-loss rate increased as a power function of pressure. Metallographic examination of axially sectioned specimens revealed undercutting and transgranular cracking as well as subsurface deformation for all materials. Author

N68-10139# IIT Research Inst., Chicago, Ill.
RESEARCH ON ZIRCALOY BRAZE ALLOY DEVELOPMENT Quarterly Report, Apr. 1–Jun. 30, 1967
D. E. Kizer and Z. P. Saperstein 17 Jul. 1967 6 p Sponsored jointly by US-EURATOM
(Contract AT(11-1)-578)
(IITRI-578-P29-14; EURAEC-1891) CFSTI: HC $3.00/MF $0.65

Most of the original braze alloy candidates have been screened for brazability and corrosion resistance in superheated water. More than 15 alloys appear promising based on these results. Six of the new alloys displayed good corrosion resistance; Pt–3.5 B, Pt–3Si, Pt–4.2Si, Zr–20Co–10Mo, Zr–15Au–15Mo, and Zr–25Cr–25Sn. The zirconium-base binaries continued to show excellent corrosion resistance after 1500 hr exposure. Preparations have been made for dynamic loop testing of the better alloys. NSA

N68-10140# IIT Research Inst., Chicago, Ill.
YIELD PHENOMENA AND FRACTURE OF HYDRIDED ZIRCONIUM Summary Report, Sep. 1, 1965–Aug. 31, 1966
I. Broverman 31 May 1967 46 p refs Sponsored jointly by US-EURATOM
(Contract AT(11-1)-578)
(IITRI-578-P27-22; IITRI-B6035-22; EURAEC-1876) CFSTI: HC $3.00/MF $0.65

The relations between yield point and strain-hardening coefficient of high-purity polycrystalline Zr (0.005 to 0.009 mm average grain diameter) with temperature (−200 to +200°C) were investigated. The yield point consistently appeared with increasing temperature, provided that the grain size was favorable. The results accentuated the first-order importance of fine-grain size in yield point occurrence. Also, the smaller-grain size was accompanied by a lower strain-hardening coefficient. For each grain size, however, the strain-hardening coefficient was statistically constant with varying temperature. The effects of temperature are explained on the basis of the viscous behavior of grain boundaries relative to grain size. By means of dynamic transmission electron microscopy dislocation behavior was observed in relatively fine-grained (≈0.005 mm) and coarse-grained (≈0.008 mm) zirconium. The effect in each material of air cooling vs water quenching from the final annealing temperature was also investigated. Considerably less dislocation generation, mobility, and interactions were found resulting from applied external stress in fine-grained material and/or in the air-cooled condition. The results supported the dynamic dislocation concept (Johnston–Hahn model) for the yield point phenomenology. The lower strain-hardening coefficient accompanying smaller grain size and/or slow cooling rate from the final annealing temperature was a manifestation of these same structural effects. Author (NSA)

N68-10146 European Atomic Energy Community, Ispra (Italy).
PRODUCTION AND PROPERTIES OF Al–Al_2O_3 DISPERSION STRENGTHENED ALLOYS FROM THIN SHEETS [HERSTELLUNG UND EIGENSCHAFTEN VON Al–Al_2O_3 DISPERSIONSLEGIERUNGEN AUS DUNNEN FOLIEN]
H. Kellerer, G. Saur, and H. Borchers Aug. 1967 279 p refs In GERMAN; ENGLISH summary
(EUR-3497.d)

To date, only powder metallurgy methods are known for the production of the Al–Al_2O_3 dispersion strengthened alloys. The present investigation concerns the production of such an alloy by a technique which utilizes thin aluminium sheet. Thin sheets, 3 μm to 40 μm thick, were wound into spools and oxidized in either air, water or vapor. Thereafter the spools were extruded into rods at temperatures of about 600°C. The extrusion process caused the superficial oxide layers to break into small particles which were distributed throughout the matrix. Metallography and mechanical property examination were used to determine the optimum conditions of fabrication of the alloy. The influence of oxide content and foil thickness on the mechanical properties were investigated. Utilizing foils of 3 μm and oxide layers of 0.2 μm maximum tensile strength of 32 kp/mm^2 at 20°C and 8 kp/mm^2 at 450°C were obtained. The results were in good agreement with the Orowan theory. Ductility depends on both volume fraction and interparticle spacing of the oxide. At the two temperatures investigated, 20°C and 450°C rather different characteristics were obtained. It is shown that microcracks may be formed during the deformation of the Al–Al_2O_3 two-phase alloys and their influence on the strength and ductility are discussed. Author

N68-10196# Battelle Memorial Inst., Geneva (Switzerland).
RESEARCH TO DETERMINE THE LONG-TERM MECHANICAL PROPERTIES OF METALS SUBJECTED TO MECHANICAL STRESS AT ELEVATED TEMPERATURES AND NEUTRON IRRADIATION Quarterly Report, 1 Jan.–31 Mar. 1967
W. Siegfried Jun. 1967 39 p refs
(Contracts EURATOM-100-62-12RDS; EURATOM-057-64-7-TEES (RD))
(EURAEC-1881; EUR-3377; QR-17) CFSTI: HC $3.00/MF $0.65

Theoretical studies were made along with investigations concerning possible errors that may occur as a result of simplifications based on the calculations. Appropriate procedures for the application of the method of evaluation developed were elaborated. The relation between the shape of the time-to-rupture curve and the volume of activation, secondary creep rate, and number of fissure germs was determined. Time-to-rupture tests on a Cr–Mo–V–cast steel with abnormal behavior were evaluated along with those on stainless alloy 304 with and without neutron irradiation. Author (NSA)

N68-10257# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
IMPERFECTIONS IN METALS. II: CORROSION AND OXIDATION Quarterly Report, Apr. 1–Jun. 30, 1966
30 Jun. 1966 17 p refs
(Contract EURATOM-054-64-4TEEB)
(EURAEC-1757; EUR-3312; QR-15) CFSTI: HC $3.00/MF $0.65

The oxide films formed under some different conditions on an AISI 304 stainless steel have been investigated by electron microscopy and electron diffraction. An influence of the electro-polishing of the metal surface was noticed as well on the nature as on the morphology of the oxide films. The anomalous behavior of the oxidation at the grain boundary area in precipitation-treated steel foils was hardly detectable in as-treated foils. The reduced oxidation in these areas was only clearly observed in foils electropolished prior to oxidation. However, no difference in composition could be detected between the grain boundary area and the inside of the grain. Author (NSA)

N68-10289* Farnham (Frank C.) Co., Philadelphia, Pa.
PRESSURE OF SATURATED VAPOR OF LIQUID CERIUM [TYSK NASYCHENOYI PARY RIDKOHO TSERIYU]
A. A. Kruhlykh and V. S. Pavlov Washington NASA Oct. 1967 5 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 9, 1965 p 1029–1032
(Contract NASw-1497)
(NASA-TT-F-11269) CFSTI: $3.00 CSCL 11F

The pressure of cerium vapor was determined in the temperature range of 1295 to 1570°C. Cerium (99.7% pure), purified by the method of zonal recrystallization, was used for the measurements. The measurements were conducted by two independent methods: by effusion and by the rate of evaporation from a cylindrical crucible. The change in weight of the container holding the substance was recorded continuously. The results obtained agree well and are described by the equation: log P = 8.81-(19,020/T). The heat of evaporation of cerium was 87.0 kcal/mole and the boiling point was 2930°C. Author

N68-10332# Oak Ridge National Lab., Tenn.
TREATMENT OF A NICKEL MELT BY MAGNESIUM, CERIUM, AND ZIRCONIUM ADDITIONS
G. M. Volkogon [1966] 7 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), v. 39, no. 6, 1966 p 85–88
(ORNL-TR-1642) CFSTI: HC $3.00/MF $0.65

The effect of the residual additive concentration on the plasticity of Ni was investigated, using a low-frequency induction furnace for preparing the melts and for deoxidizing the Ni by means of C or C+Su+Si, keeping the liquid metal at 1550°C. Hot-forged specimens were used to study the effect of residual additives. It was found that the plasticity is dependent not only on the added material but also on the soaking period. Addition of Ce, Mg, and Zr exerted a strong refining effect, reducing markedly the concentration of harmful impurities, gases, and nonmetallic occlusions. Large residual amounts of these elements were found to form an independent phase at the grain boundary, increasing the brittleness of the alloy. The surface of the castings was clean and free from cracks and pores. The plasticity of Ni foils treated with Mg decreased rapidly in the intermediate temperature range; treatment with Ce and Zr resulted in an increase of the plasticity with increasing temperature. Best results were obtained by adding the alloying agent at 1550°C at a rate of 0.1% and soaking the mixture for 6 minutes after the addition. NSA

N68-10377# Oak Ridge National Lab., Tenn.
EFFECT OF CARBON ON THE PRIMARY CRYSTALLIZATION OF LOW CONTENT U–Mo ALLOYS [INFLUENCE DE CARBONE SUR LA CRISTALLISATION PRIMAIRE DES ALLIAGES U–Mo DE FAIBLES TENEURS]
Michel Colombie and Jacques Decours Dec. 1966 44 p refs Transl. into ENGLISH from French Rept. CEA-R-3093
(ORNL-TR-1668; CEA-R-3093) CFSTI: HC $3.00/MF $0.65

The effect of addition of small amounts of C on the primary crystallization of 1.1% U–Mo alloys was studied. The primary γ-crystallization-rate curves, as a function of the C concentration for a given cooling speed, showed a maximum. The maximum decreased from 800 to 500 ppM if the cooling speed was increased. But the maximum disappeared if the cooling speed became too small. The mechanism for the C effect is discussed. Four methods for preparation of low-C-content U–Mo alloys were investigated: preparation beginning with graphite powder, with molybdenum carbide, with CO_2 bubbling, and with an arc furnace. The arc-furnace method was the only one that gave homogeneous concentrations above 1500 ppM. NSA

N68-10431# Navy Dept., Washington, D. C. Naval Intelligence Command.
COLD BRITTLENESS AND MAXIMUM PLASTICITY OF METALS IN SHIPBUILDING
Ye. M. Shevandin and I. A. Razov 14 Aug. 1967 356 p Transl. into ENGLISH of the Russian book
(NIC-TRANS-2436; TT-67-62983; AD-659191) CFSTI: HC $3.00/MF $0.65

The results of experimental investigations and theoretical correlations on questions of cold brittleness and maximum plasticity of low-carbon and low-alloy steels, used in shipbuilding, are presented. The effect of different factors - temperature, rate of loading, state of stress, size and elastic energy - on cold brittleness and maximum plasticity of metals is analyzed. Results of design tests (beams, decks, etc.) in static and dynamic loading under conditions of brittle and ductile fractures are presented. A method of evaluating toughness and maximum plasticity of metals in parts and elements of structures is proposed. Author (TAB)

N68-10491# Lehigh Univ., Bethlehem, Pa. Dept. of Metallurgy and Materials Science.
FINE STRUCTURE PRODUCED BY CYCLIC MARTENSITIC TRANSFORMATION Final Report
George Krauss 30 Sep. 1967 6 p refs
(Contract DA-31-124-ARO-D-237)
(AROD-4806-4-MC; AD-659405) CFSTI: HC $3.00/MF $0.65

The results are presented of investigations of the enhancement of martensitic transformation after cyclic martensitic transformation, and the FCC to BCC transformation in iron-nickel alloys containing between 7 and 25 percent nickel. TAB

N68-10498*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF ELECTRIC POTENTIAL ACROSS THE OXIDE SCALE DURING OXIDATION OF TANTALUM, NIOBIUM, AND MAGNESIUM
I. Zaplatynsky Washington Nov. 1967 9 p refs
(NASA-TN-D-4240) CFSTI: HC $3.00/MF $0.65 CSCL 11F

According to Hauffe's theoretical treatment of the oxidation of metals, the oxide-gas interface is electrically negative with respect to the oxide-metal interface. The potential difference is considered to be one of the driving forces for oxidation. Experimental evidence, presented here, does not support this assumption. The polarity of measured potential is reversed and has a retarding effect on oxidation. The magnitude of the potential and its temperature dependence were determined for tantalum, niobium, and magnesium during oxidation in air. The magnitude of the potential does not depend upon oxide thickness. Features of the potential-temperature curves for tantalum and niobium correspond to significant changes in the oxidation rates of both metals. Author

N68-10512*# Aerojet-General Corp., Sacramento, Calif.
INVESTIGATION OF THE GOLD BRAZE ALLOYS WITH AEROZINE 50
8 Nov. 1967 20 p
(Contract NAS9-7567)
(NASA-CR-65806; Rept.-3332) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A two-part experimental study was conducted to determine the compatibility of AeroZINE 50 with two gold-based braze alloys under consideration for use in fabricating the Apollo lunar module heat exchanger. Emission spectrography was employed to measure the total quantities of gold, nickel, and palladium in AeroZINE 50, AeroZINE 50 containing 0.5% ammonia, and in AeroZINE 50 containing 0.5% chloride ion after these fuels were exposed for 48 hours at 150° to the alloy specimens. The purpose was to establish whether or not the metals appeared in the fuel in sufficient quantities to constitute a potential hazard if they were in the form of explosively unstable compounds. Also determined was the decomposition rate of the three fuel types during their exposure to the alloys at 150°F, by observing the pressure changes developed in a manometric vessel. The data obtained show that the gold-based alloys are compatible with AeroZINE 50 even when excessive amounts of ammonia or chloride ion are present in the fuel. M.G.J.

N68-10523# Israel Inst. of Tech., Haifa. Material Mechanics Lab.
DISCONTINUOUS YIELDING OF METASTABLE AUSTENITIC STAINLESS STEEL
J. Baruch, A. Rosen, and S. R. Bodner Aug. 1967 31 p refs
(Contract AF 61(052)-951)
(MML-9; AFOSR-67-2310; SR-6; AD-659368)

Constant straining rate and constant loading rate tensile tests were performed on stable and unstable austenitic stainless steels. The results shown that under certain conditions of temperature, testing speed and environment, the stress strain curves of the unstable alloy, Type 301 stainless steel, are stepped or serrated depending upon whether the test was performed under constant rate of loading or constant rate of straining. Discontinuous yielding occurred almost exclusively in the range where the flow stress is a decreasing function of strain rate. The decrease of flow stress with increasing strain rate is a result of a time-temperature dependent martensitic transformation of the metastable austenite. For the stable alloy, Type 316 stainless steel, the flow stress always increased with strain rate and the corresponding stress strain curves were smooth. Author (TAB)

N68-10560# Aerospace Corp., El Segundo, Calif. Labs. Div.
ELASTIC BEHAVIOR OF MgO MATRIX COMPOSITES, 1 JANUARY–30 JUNE 1966
Kenneth R. Janowski and R. C. Rossi Jun. 1967 35 p refs
(Contract AF 04(695)-1001)
(TR-1001(2250-10)-7; SSD-TR-67-148; AD-659134)

The Youngs and shear moduli of MgO-porosity and MgO-porosity-Ni composites were measured at low concentrations of the included phases. The effect of the included phases was observed to be greater than that which would have been predicted from theory. The deviation between the experimental data and theory was explained on the basis of the shape of the included phases. The Youngs and shear moduli for fully dense MgO were determined as 3070 and 1305 kbars, respectively. Author (TAB)

N68-10575# Air Force Systems Command, Wright-Patterson, AFB, Ohio. Foreign Technology Div.
MODIFIED METALS AND ALLOY STRUCTURES
M. V. Mal'tsev 2 May 1967 207 p refs Transl. into ENGLISH of the book "Modifitsirovaniye Struktury Metallov i Splavov" Moscow, Izdatel'stvo Met., 1964 p 1–214
(FTD-MT-65-524; AD-659662)

The book was written for plant personnel and the staffs of scientific-research institutes in the metallurgical and machine-building industries. Problems in the theory and practice of modifying metals and alloys are presented. Author (TAB)

N68-10591# Aerospace Corp., El Segundo, Calif. Labs. Div.
EFFECTS OF GRAIN SIZE ON THE DISLOCATION DENSITY AND FLOW STRESS OF NIOBIUM, DECEMBER 1964–DECEMBER 1966
Hans Conrad, Seymour Feuerstein, and Larry Rice Apr. 1967 43 p refs
(Contract AF 04(695)-1001)
(TR-1001(2250-20)-6; SSD-TR-67-145; AD-659133)

Effects of grain size from 32 to 435 micron on the dislocation density and distribution and on the yield and flow stresses of 125-micron-thick niobium foil pulled in tension at room temperature (300K) were investigated. For a given grain size, the dislocation density initially increased in an approximately linear manner with strain; for a given strain, the dislocation density was proportional to the reciprocal of the grain size. The tensile flow stress Sigma increased with the square root of the dislocation density, yielding the relation Sigma = Sigma f + 0.88 Gb rho 1/2 where Sigma f was independent of grain size when the grain diameter was less than the foil thickness. A significant part of Sigma f was identified with the thermally activated nucleation of kinks. The effect of grain size on the lower yield and flow stresses of the fine-grained niobium is explained in terms of a work-hardening model. A cellular network of dislocations developed for strains of the order of 10%. The strain at which the network was first well defined increased with grain size. Once the cell was formed, the cell size tended to decrease with further straining. Cell size at a given strain was proportional to the square root of the grain diameter and was approximately equal to the average dislocation spacing, assuming a random distribution. Flow stress increased linearly with the reciprocal of the cell size. Author (TAB)

N68-10596# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
FORMATION AND CHARACTERIZATION OF THE A 15-TYPE STRUCTURE IN CHEMICAL VAPOR DEPOSITED TUNGSTEN–RHENIUM ALLOYS
John Irvin Federer (M.S. Thesis—Tenn. Univ., Knoxville) Aug. 1967 49 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1888) CFSTI: HC $3.00/MF $0.65

An A15-type phase was identified in vapor-deposited W–Re alloys by X-ray and neutron diffraction, metallography, and hardness measurements. The crystal structure was established as an A15 type by comparing experimental X-ray and neutron diffraction integrated intensities with calculated intensities based on the usual atomic arrangement for A15-type phases. The composition range for the existence of this phase varied with temperature, but was near W_3Re; in the temperature range investigated, 1000 to 1500°C, the phase occurred alone or coexisted with the tungsten-rich terminal solid solution (β phase) or with σ phase. The phase was about four times harder than the β phase, possibly limiting the usefulness of alloys containing the A15 phase as a major constituent. Author (NSA)

N68-10598# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
A STUDY OF DISLOCATION MOBILITY AND DENSITY IN METALLIC CRYSTALS Annual Summary Report, Period Ending Jul. 1967
T. Vreeland, Jr. and David S. Wood Aug. 1967 11 p
(Contract AT(04-3)-473)
(CALT-473-21) CFSTI: HC $3.00/MF $0.65

Refinements in the application of the Berg–Barrett X-ray method to the observation of individual dislocations in metallic crystals were made and applied to dislocation studies. Basal dislocation velocities in Zn were measured as a function of applied shear stress and the velocity-controlling mechanisms were studied. Studies on the dislocation velocity and slip on the $(\bar{1}2\bar{1}2)\langle\bar{1}2\bar{1}3\rangle$ systems of Zn were completed. Pyramidal slip at temperatures below about 110°K was thermally activated. The temperature dependence of dislocation mobility in Cu is being studied. Mechanisms governing dislocation mobility in Al are also being investigated. Samples are being prepared for studies of the effects of carbon on dislocation mobility in Si–Fe systems. NSA

N68-10679# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
CORROSION AND HYDRIDING OF ZIRCALOY Quarterly Technical Progress Report, Apr. 1–Jun. 30, 1967
Aug. 1967 27 p refs Sponsored Jointly by US-EURATOM
(Contract AT(30-1)-3765)
(BAW-3765-3; EURAEC-1887; QTPR-3) CFSTI: HC $3.00/MF $0.65

Corrosion and hydriding tests of Zircaloy under heat transfer conditions to determine the quantity of hydrogen absorbed during

service, and mechanical property tests of hydrided Zircaloy to determine the effect of H_2 on cladding properties are reported. Gaseous hydriding and oxidation in air have been successful in preparing specimens to simulate fuel cladding after 1000 days service. Analytical data indicate that the heat transfer and isothermal loop specimen absorbed considerably more H_2 than did the autoclave specimens. The tensile data show that H_2, at concentrations up to 1000 ppM, has no significant effect on the tensile strength of cold-worked Zircaloy-4 tubing over a temperature range from 70 to 800°F. At temperatures below 250°F and H_2 concentrations above 900 ppM, the tensile elongation of cold-worked tubing is significantly reduced. The elongation values were reduced from 16% for as-received material to less than 6% for material containing 1000 ppM hydrogen. At temperatures above 250°F, elongation is insensitive to hydrogen content, and below 250°F, there is no appreciable effect for less than 300 ppM hydrogen on any of the mechanical properties measured. NSA

N68-10698# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PREPARATION OF IRRADIATED HIGH-TEMPERATURE SERVICE NICKEL BASE ALLOYS FOR METALLOGRAPHY

W. J. Gruber [1967] 9 p refs Presented at the 21st AEC Metallog. Group Meeting, Upton, N. Y.

(Contract AT(45-1)-1830)

(BNWL-SA-1112; CONF-670533-3) CFSTI: HC$3.00/MF$0.65

Irradiated tensile samples fabricated from several Ni-base alloys were examined metallographically after testing to study microstructural relations to physical properties, testing criteria, irradiation induced phenomena, and heat treatment histories. Specimens were examined optically and replicas were made for electron microscopy. Preparation, etching, and replicating techniques are described; differences between irradiated and non-irradiated materials are discussed; and illustrations of results are presented. Author (NSA)

N68-10719# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF LANTHANUM AND YTTRIUM ON THE RECRYSTALLIZATION OF MOLYBDENUM [VLIYANIYE LANTANA I ITTRIYA NA REKRISTALLIZATSIYU MOLIBDENA]

V. P. Gol'tsev 28 Feb. 1967 9 p refs Transl. into ENGLISH from Akad. Nauk Belorussk. SSR (USSR), v. 10, no. 3, 1966 p 196–198

(FTD-HT-67-29; TT-67-63064; AD-659666)

Specimens of sintered molybdenum alloys containing 0.06–0.2% lanthanum or 0.03–0.1% yttrium were vacuum annealed at 1673K, rolled at 1133K with a total reduction of 70%, and again vacuum annealed at 1173–1873K to determine the effect of La and Y on the alloy recrystallization behavior. It was found that additions of up to 0.1% yttrium or up to 0.2% lanthanum insignificantly increase the temperature of the beginning of recrystallization. On the other hand, even very small additions of yttrium or lanthanum (0.03–0.06%) sharply increase the temperature of the end of recrystallization. The temperature range between the beginning and the end of recrystallization of molybdenum alloy containing lanthanum or yttrium is rather wide and reaches 250–300K. In alloy with 0.2% lanthanum, the first recrystallized grains are formed at 1273K and the recrystallization ends at 1573K. At 1673K, the grain growth begins, but the grain size does not exceed 20–25 microns. Only at 1873K does the grain size increase substantially. Lanthanum and yttrium react with interstitial impurities and act as deoxidizers refining the grain boundaries. It appears that the recrystallization behavior of the alloys tested is a result of the presence of finely dispersed particles of the secondary phase, the products of deoxidation. Author (TAB)

N68-10741# Army Materials Research Agency, Watertown, Mass.

BIAXIAL TENSILE BEHAVIOR OF Ti-5Al-2.5Sn ALLOY

Joseph L. Sliney Jun. 1967 28 p refs

(AMRA-TR-67-22; AD-659335)

The elastic and plastic tensile properties of two sheets of 5Al-2.5Sn titanium alloy were determined. The effect of various annealing temperatures up to 1900 F on these properties were obtained on one sheet. Two closed-end cylindrical pressure vessels which had reduced wall thicknesses away from the longitudinal and circumferential welds were fabricated from each sheet. Two of the pressure vessels from one sheet exhibited yield improvements which were slightly lower than those predicted by the Hill-Backofen anisotropic yield criterion. The other two vessels yielded at less than that predicted by the Von Mises yield criterion. All vessels exhibited exceptionally high burst strengths as compared to the uniaxial tensile strengths. Author (TAB)

N68-10756# Virginia Univ., Charlottesville.

AN INVESTIGATION OF SOME PROPERTIES OF THREE DIMENSIONAL VOIDS IN FACE CENTERED CUBIC METALS

Julius Alfred Sigler (Ph.D. Thesis) 1 Aug. 1967 94 p refs

(Contract AT(40-1)-3108)

(ORO-3108-29) CFSTI: HC$3.00/MF$0.65

From data obtained for relative density changes as a function of strain in Au, it was concluded that there is no increase in density for small strains, and thus, that voids are not present in appreciable extent in furnace-cooled gold. The calculated value for the volume deficiency per dislocation segment is too high. A model was formulated and employed to explain the collapse of voids in quenched metals, and to a first approximation, the calculated results for the time of collapse as a function of quenching temperature are in good agreement with the observed behavior of Ni and Au. NSA

N68-10778# Oak Ridge National Lab., Tenn.

EFFECTS OF THERMAL TREATMENT ON THE STRUCTURE OF URANIUM ALLOYS CONTAINING NIOBIUM [INFLUENZA DEI TRATTAMENTI TERMICI SULLA STRUTTURA DI LEGHE DI URANIO A BASSO TENORE DI NIOBIO]

C. Fizzotti and A. Masperoni 1966 23 p refs Transl. into ENGLISH from Italian

(ORNL-TR-1695; RT/MET/66/1)

A few U alloys containing up to 5 wt % Nb were aged at 550°C after having been continuously cooled at different rates from the γ phase. The change of the structure occurring on aging is described and discussed. Step-annealing in the binary phase fields ($\beta+\gamma_1$), ($\alpha+\gamma_1$), and ($\alpha+\gamma_2$) were also performed and described. A portion of the binary system U–Nb, near the U side, was revised and the obtained results were compared with previous ones. Author (NSA)

N68-10799# Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering.

THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION Quarterly Report

Thomas B. Cox Jun. 1967 14 p refs

(Contract AT(40-1)-3208)

(EURAEC-1902; QR-438-12) CFSTI: HC$3.00/MF$0.65

The results from stress corrosion tests performed in Type 304 stainless steel plates are presented. The plates were subjected to various N_2 bearing atmospheres for 24 hr at 538°C. To make certain that the specimens were homogeneous in nitrogen content, they were encapsuled individually under a vacuum in quartz tubing and held at an elevated temperature for annealing. Annealing results for 1800°F and 2000°F are presented. NSA

N68-10858# Chantiers de l'Atlantique Saint-Nazaire (France).
[MECHANICAL PROPERTIES OF STEELS] Quarterly Report, Apr. 1–Jun. 30, 1967
7 Jul. 1967 3 p In FRENCH
(Contract EURATOM-054-61-12 RDF)
(EURAEC-1889; EUR-3383; QR-9) CFSTI: HC $3.00/MF $0.65

Tempering treatment results for steels of Soudotenax 44, Soudotenax 56, 1.2 MD 07, Wel Monix, and PM 24 are presented. Increased tempering treatments lowered impact strength; short tempering improved impact strength. Stress relief tests for 75% to 80% were performed for steels of WSB 62, 302 B, Wel Monix, and PM 24. Stress relief curves confirm the existence, for certain number of steels, of an acceleration of the stress relief in materials in the normalized state at a temperature of 350° to 450°C. NSA

N68-10861# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE INFLUENCE OF THERMOMECHANICAL TREATMENTS ON THE STRENGTH, HIGH TEMPERATURE STABILITY, AND MICROSTRUCTURE OF HASTELLOY X-280
I. S. Levy 10 Aug. 1967 16 p refs Presented at the Intern. Conf. on the Strength of Metals and Alloys, Tokyo, 4–8 Sep. 1967 Submitted for publication *Its* Conf. Paper No. 71
(Contract AT(45-1)-1830)
(BNWL-SA-1183; CONF-670909-3) CFSTI: HC $3.00/MF $0.65

Specimens of Hastelloy X-280, a low-cobalt version of the solid-solution-hardened Ni-base alloy Hastelloy X, were given a series of thermomechanical treatments, after which they were exposed at either 540°F for 450 hrs or 1250°F for more than 1500 hrs. The specimens were then subjected to tensile and creep–rupture tests at 1350°F and to microstructural examinations. Creep–rupture tests in specimens exposed at 540°F showed that reductions in creep rates of up to a factor of 14 occurred as a result of these treatments. This strengthening resulted from dislocation networks and precipitates produced by the treatments. Tensile tests on specimens exposed to 1250°F showed a general increase in strength and decrease in uniform elongation with increasing cold work levels in the treatments. One treatment produced a 25% increase in yield strength with little loss in ductility relative to the standard treatment. Microscopy showed that this was due to dislocation tangling, which was not eliminated by the exposure, and to the precipitates developed by treatments. A comparison of the tensile data for the 540 and 1240°F exposures revealed that the 1250°F exposure produced a general increase in yield strength and decrease in uniform elongation relative to the 540°F exposure. Microscopy showed this to be due to hardening by precipitates that formed during the 1250°F exposure. Some of the thermomechanically treated specimens incurred much less strength increase and ductility loss after this exposure than did the standard-treatment specimens. Microscopy revealed that this better stability was a result of extensive precipitation that formed during the treatments, which led to microstructures that were less susceptible to further precipitation during the 1250°F exposure. Author (NSA)

N68-10888 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE CREEP OF METALS
T. B. Larina [1967] 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Leningrad), v. 175, no. 5, Aug. 1967 p 1030–1032

Equations are developed to describe creep when a load is applied instantaneously and then remains invariant. Relaxation tests and elastic and plastic strain are considered. The problem of loading a semi-infinite rod is investigated, and it is found that a disturbance is propagated at approximately the same velocity as it had at the beginning. The formation of a shock wave, which may cause microdefects, is described. N.E.N.

N68-10890 Technische Hochschule Hannover (West Germany).
THE DEFORMATION PROPERTIES OF REACTIVE METALS WITH HIGH MELTING POINT [DIE STAUCHEIGENSCHAFTEN REAKTIVER UND HOCHSCHMELZENDER METALLE]
Hans-Wilfried Wagener (Ph.D. Thesis) 1965 179 p refs In GERMAN

The deformation properties of titanium, titanium alloys, zirconium, Zircaloy-2, niobium, tantalum, molybdenum, and tungsten were investigated in order to obtain empirical data for establishing analytical methods for determining the strength of these metals and alloys. Technologically the aim was to contribute to the macroscopic knowledge of the deformation processess in polycrystalline metals with hexagonal and cubic space-centered lattice structures. In addition, data were sought on the effects of the lattice type on the coefficients of hardening, deformation rate, and temperature. Experiments were conducted on a deformation press to determine deformation strength, strain resistance, and the logarithmic boundary deformation ratio, taking into account the effects of deformation rate and temperature. Transl. by K.W.

N68-10897# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
FATIGUE CRACK GROWTH RATES IN UNIRRADIATED PRESSURE VESSEL STEEL
E. E. Baldwin and D. F. Mowbray [1967] 18 p refs Presented at the Irradiation Effects on Reactor Structural Mater. Conf., Washington, D. C., 18–21 Jul. 1967
(Contract W-31-109-ENG-52)
(KAPL-P-3362; CONF-670721-2) CFSTI: HC $3.00/MF $0.65

Fatigue crack growth rate data were obtained for A302-B and A508 class 2 steels. Plate specimens containing two types of flaw geometry were tested. One type had cracks emanating from a centrally located, through the thickness, hole. The other type had a central surface crack with a semi-elliptical crack front. The tests were conducted at room temperature on load-controlled hydraulic testing machines of 120,000 to 300,000 lb capacity. Cyclic stress levels based on the gross cross-sectional area of the specimen gage section were varied from 38,000 to 67,500 psi. Data are presented in graphs. They indicate that the stress-intensity hypothesis results in an excellent correlation of the through-plate crack data. For both the A203B and the 508-2 material there was more resistance to fatigue crack growth in the thickness than in the transverse direction. NSA

N68-10904 Montreal Univ. (Quebec). Div. of Applied Mechanics.
CREEP FATIGUE OF PRESSURE VESSEL STEEL
J. Dubuc and A. Biron Risley United Kingdom Atomic Energy Authority 1967 63 p refs
(TRG-1537(C/X))

Low-cycle fatigue tests were carried out at 2 c.p.m. on a pressure vessel steel at 350°C (662°F). The total strain range was set for each test and the minimum strain in some cases was constant (zero value), in others varied uniformly in time at a pre-determined rate. It was found that variations in the minimum strain up to 0.5% hour had no significant influence on the results. Author

N68-10908# Atomic Weapons Research Establishment, Aldermaston (England).
ATMOSPHERIC OXIDATION OF PLUTONIUM METAL. PART 2
J. F. Sackman [1967] 27 p refs
(AWRE-O-4/62) CFSTI: HC $3.00/MF $0.65

The oxidation behavior of α–Pu is shown to be complex and to depend largely on small variations in metallurgical history. Rates of oxidation of different specimens of metal under identical conditions can vary by a factor of up to 40. Under humid conditions, deep cracks appear in the metal after very little oxidation, and these lead to the disintegration of the specimens at an early stage.

Attention was paid to the products of oxidation, and both water and CO_2 were shown to be present. Author (NSA)

N68-10910 Technische Hochschule Hannover (West Germany).
ON THE WEAR PROPERTIES OF DIE STEELS [BEITRAEGE ZUR KENNTNIS DES VERSCHLEISSVERHALTENS VON GESENKSTAEHLEN]
Felix Theodor Netthoefel (Ph.D. Thesis) 1965 112 p refs In GERMAN

Investigated were 20 steel combinations for their wear resistance in drop-forging tools. Screw press tests on various steel pins showed that their wear behavior depended on the temperature–time factor, the material's density, and the alloying effects of tungsten and molybdenum components. Only those elements that formed carbides influenced the wear behavior of investigated steel pins. Transl. by G.G.

N68-10918# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
WARM PRESTRESSING OF PRESSURE VESSEL STEELS
W. R. Andrews, E. E. Baldwin, and F. D. Lordi [1967] 13 p Presented at the Irradiation Effects on Reactor Structural Mater. Conf., Washington, D. C., 18–21 Jul. 1967
(Contract W-31-109-ENG-52)
(KAPL-P-3350; CONF-670721-1) CFSTI: HC $3.00/MF $0.65

An investigation is in progress to determine if warm prestressing will reliably result in beneficial effects to determine the extent of these effects and to study the mechanism involved. The material being used is Ni–Cr–Mo steel. Fatigue-cracked bend bars are being preloaded as a simple beam with the notch on the tension side. The specimens are then tested to failure via a specific load-temperature path. Some data are presented in tables and graphs. NSA

N68-10922 Ministry of Technology, London (England). Directorate of Materials Research and Development.
FACTORS AFFECTING THE ADHESION OF SURFACE COATINGS TO ANODISED ALUMINIUM ALLOYS
A. R. Popley, C. A. Terry, and P. Walker Jun. 1967 138 p refs
(Contract KS/1/0341/C.B.43(a)2)
(AWRE-O-22/67; Rept.-146)

An investigation has been carried out into the factors effecting the adhesion of aircraft paint systems to anodized aluminium and aluminium alloys. The equipment used in the chromic and sulphuric acid processes on both plant and laboratory scale is described in detail and analysis figures for the baths and post anodizing treatments are detailed. The panel preparation and experimental procedure for the determination of the adhesion of the surface coatings by the direct pull-off sandwich technique are described. The effect of such bath composition variables as age of bath, the presence of inorganic and organic contamination, CrO_2 content and type of water, together with the effect of rinsing waters, chromate contamination, sealing temperature, and delay period before application of the paints has been studied. The adhesion of the test paint systems was assessed under three conditions of aging. Inorganic contamination present during post anodizing treatments has an adverse effect on paint adhesion, but when present during anodizing, does not appear to have any marked effect. Organic contamination present during anodizing is also associated with an increase in apparent adhesion failures particularly when etch primers are used. The majority of adhesion failures are associated with the anodic film on L70 alloy especially when phenolic modified etch primer to DTD5555 is used. Micrography has shown that cohesional failures is the real explanation for many of the apparent adhesion failures. Author

N68-10924# Jernkontorets Forskning, Stockholm (Sweden).
PLASTIC DEFORMATION OF METALS. THE SYMPOSIA AT JERNKONTORETS FORSKNING, APRIL 28, 1966 [METALLERS PLASTISKA DEFORMATION. FOEREDRAG VID JERNKONTORETS SYMPOSIUM DEN 28 APRIL 1966]
1967 120 p refs In SWEDISH
(NP-16905; CONF-660457)

Ten papers presented at the conference are given. Topics covered include: dislocations and plastic deformation; microstructure and plastic deformation; influence of chemical composition on deformation hardness in austenitic stainless steels; continium theory for plastic deformation; characteristics of the deformation pattern in some industrial molding processes; high-pressure forming of powdered materials; problems in estimating the hot-workability of steel-ingots; influence of rolling temperature on grain in hot-rolled aluminum; model tests and model materials for experimental studies of plastic deformation; and deformation behavior in bulging applied to other deformation processes. Author (NSA)

N68-10984 European Atomic Energy Community, Ispra (Italy).
CREEP BEHAVIOUR OF SAP-ISML [COMPORTEMENT DU SAP-ISML AU FLUAGE]
P. Bonnet, M. Grin, and G. Mathey Brussels EURATOM 1967 104 p refs In FRENCH; ENGLISH summary
(EUR-3566.f)

This report gives the present state of the research on SAP creep. After a short review of the methods of preparing the material and of its mechanical properties, the authors show the results obtained during 280,000 hours of creep. The study deals with the analysis of creep curves and creep rupture curves, and discusses the various theories on the mechanism of SAP creep as a function of different metallurgical factors, especially dispersion, extrusion conditions, and heat treatment. The authors then present a study of the SAP creep above the matrix melting-point, in relation to the hypothesis of Meyers and Sherby. Author

N68-10989# Oak Ridge National Lab., Tenn.
MECHANICAL BEHAVIOR OF CHEMICALLY VAPOR DEPOSITED TUNGSTEN AT ELEVATED TEMPERATURES
H. E. McCoy, Jr. and J. O. Stiegler Sep. 1967 32 p refs Conf. on Chem. Vapor Deposition of Refractory Metals, Alloys and Compds. held in Gatlinburg, Tenn., 12–13 Sep. 1967
(Contract W-7405-ENG-26)
(ORNL-4162)

Many applications of chemically vapor deposited (CVD) W require that the material be stressed at elevated temperatures. Creep–rupture tests results at 1650 and 2200°C to evaluate the mechanical behavior of this material, and property comparisons with those of a typical heat of powder metallurgy (PM) W are are presented. At 1650°C the CVD product has low fracture strains (approx 5%) and a lower minimum creep rate. At high stresses the rupture life is shorter than that of the PM material; at low stresses the rupture lives are about equivalent. At 2200°C the minimum creep rate is higher and the rupture life lower for the CVD product. Two microstructural features of importance were noted in the CVD W: the formation and growth of voids and the columnar nature of the grains. Fractographic techniques were used to study void nucleation and growth in the material. Nucleation appears to be spontaneous as the material is heated to elevated temperatures, indicating the presence of an impurity having a high vapor pressure. The growth appears to occur almost entirely by the stress-induced diffusion of vacancies into the void. At 2200°C under stress the voids reach such a large size that they comprise about 10% of the test specimen. The columnar grain structure of the material is important because it is very difficult to get extensive grain-boundary sliding and rotation in this type of structure. Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-10026* National Aeronautics and Space Administration, Washington, D. C.
DEFECTS OF HIGH SILICIOUS BOROSILICATE GLASSES DURING MELTING [KOKEISAN NO HOKEISAN GARASU NI OKERU YOYU KETTEN]
Osamu Yanagida, Kenji Nakagawa, and Tersuro Izumitani Oct. 1967 18 p refs Transl. into ENGLISH from Yogyo Kyokai Shi (Tokyo), v. 74, no. 2, 1966 p 45–52
(NASA-TT-F-11332) CSCL 11B

Pyrex glass with high silica-content is more difficult to be melted homogeneously than other glasses, because striae, knots, and stones very often arise during melting. The cause of striae, knots, and stones arising during melting in commercial Pyrex glasswares is examined. Experimental equipment used was centrifuge, interferometer, and strain analyzer. Most of striae have lower refractive index. They arise from raw material difficult to melt, SiO_2, at early stage. At later stage they mainly arise from surface volatilization. The striae with higher refractive index arise from Al_2O_3, ZrO_2 exuded by refractory corrosion, and also stagnants which originate from refractory corrosion have higher refractive index. The knots occur mainly from segregation of silica sands in raw materials and the refractive index is lower. But the knots with higher refractive index can be seen occasionally. They arise in the melting process of stones from refractories. The stones almost arise from segregation of silica sands in raw materials as well as knots. The refractive index of the surrounding glass is lower than that of the parent glass. The stones with higher refractive index originate from refractories. Author

N68-10075# Hercules Powder Co., Wilmington, Del.
HI-FAX POTENTIALS IN THE WIRE AND CABLE INDUSTRY
J. B. Martin, W. O. Bracken, and E. W. Cronin [1967] 15 p
(AD-656509)

Hi-fax, with its electrical characteristics and its resistance to heat, abrasion, cut-through, and stress corrosion has properties which will be utilized in both the communication and power cable fields. TAB

N68-10128* Monsanto Research Corp., Dayton, Ohio. Dayton Lab.
DEVELOPMENT OF IMPROVED STRUCTURAL ADHESIVES Annual Summary Report, 27 Jul. 1966–30 Jul. 1967
D. Gerald Glasgow, Charles E. Mc Clung, and Archie E. Follett 30 Jun. 1967 75 p refs
(Contract NAS8-20406)
(NASA-CR-90034; ASR-1) CSCL 11A

A structure-property study of polyurethane adhesives has resulted in the development of two compositions which have satisfactory bulk properties but lack the necessary adhesion to aluminum needed to completely meet the desired tensile shear and T-peel strengths over the range of −253°C to +150°C. These systems have excellent properties at cryogenic temperatures but one is 20–500 psi below the 150°C tensile shear target of 1500 psi. The other is slightly deficient (16 piw vs 20 piw) in 150°C T-peel strength. Both formulations meet the fabrication condition requirements with the exception of inadequate pot life (30–60 minutes vs the goal of 120 minutes). An investigation of both aliphatic isocyanurates and polyetherurethane/aromatic isocyanurate systems as adhesives gave poor T-peel strengths at crosslinking levels sufficient for adequate tensile shear strengths. Author

N68-10157# Monsanto Chemical Co., St. Louis, Mo. Organic Chemicals Div.
THE TESTING OF POLYVINYLCHLORIDE ELECTRICAL FORMULATIONS
George W. Ashworth, Joseph R. Darby, William E. Koerner, and Ralph H. Munch [1966] 27 p
(AD-656404)

Data are presented which show that test methods which closely simulate specification conditions must be used to measure accurately the electrical quality of insulating materials and their ingredients. A novel molded specimen for studying the long-term water immersion resistivity of polyvinyl chloride electrical insulating compounds has been developed. It permits determining the quality of ingredients used in such compounds at much lower cost using smaller amounts of material, simpler equipment and much less space. Up to 84 samples can be tested in a 1.5 ft. x 2 ft. x 1 ft. bath. Author (TAB)

N68-10216*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A NEW DEFORMATION MECHANISM IN PYROLYTIC CARBON AT HIGH TEMPERATURES
G. M. Jenkins 1967 25 p refs Lecture on Mater. Sci. held in Swansea (Wales)
(Contract NAS7-100)
(NASA-CR-90028) CFSTI: HC$3.00/MF$0.65 CSCL 11B

It is demonstrated that the creep deformation of pyrolytic graphite at high temperatures in response to a stress in an a-direction may be the result of the independent two-dimensional plastic distortion of each individual plane of carbon atoms. On the model the distortion within each plane is produced by the movement of unit c-axis dislocations mainly by climb from a generalized Herring–Nabarro mechanism. This has some bearing on creep in polycrystalline graphite at high temperature and under neutron irradiation. Author

N68-10229# Army Electronics Labs., Fort Monmouth, N. J. Army Signal Engineering Labs.
AGING OF NEOPRENE IN A WEATHEROMETER
G. N. Vacca and C. V. Lundberg [1967] 30 p refs
(AD-656500)

An investigation was made of the effect of comparatively long exposure of neoprene jackets in an accelerated weathering device. At the same time, it was hoped that the effect on weathering of lowering the neoprene content of a jacket could be determined. On the basis of the work done, it appears that a weatherometer such as the one used does not contribute materially to the estimation of expected outdoor service life of neoprene jackets. An accelerated ozone test in conjunction with a 100C air oven test gives a reliable criterion of expected service life in a comparatively short time, certainly much shorter than that required for the weatherometer test. In the case of GR-S jackets, however, the weatherometer may be much more useful. TAB

N68-10271# Vermont Univ., Burlington.
THE FRACTURE ENERGY OF COMPOSITE MATERIALS Final Report, 1 Sep. 1966–31 Aug. 1967
John O. Outwater and William O. Carnes 30 Sep. 1967 38 p refs
(Contract DA-AA-21-67-C-0041)
(AD-659363)

A critical analysis of the sources of fracture energy in a composite material showed it to be dependent on the energy of debonding of a single fiber from the matrix material. This energy

was measured using a novel technique. A theoretical basis for the fracture energy of a composite was developed relating it to the geometry, debonding energy and frictional force on an individual fiber. It showed that we can expect a more brittle composite if we reduce the fiber diameter, increase the bonding energy, increase the frictional force, or reduce the fiber density in the laminate. These factors appear to be confirmed in actuality. Measurements were also made on the fracture velocity of a crack through resin showing it to be made up of a high velocity region and a low velocity region with substantially similar fracture energies. The actual crack velocity depended on the relative lengths of cracking time at the two different velocities. Author (TAB)

N68-10456# Sandia Corp., Albuquerque, N. Mex.
RESISTANCE OF WIRE EMBEDMENTS IN SILVER-FILLED EPOXY ADHESIVES
N. J. de Lollis and O. Montoya Aug. 1967 12 p
(Contract AT(29-1)-789)
(SC-DR-67-425) CFSTI: HC $3.00/MF $0.65

Data are presented to show that silver-filled epoxy adhesives are stable and result in low resistance assemblies for long periods at high temperatures. The instability of certain metal combinations seems to be the principal reason for increased resistance. Author (NSA)

N68-10494 College of Aeronautics, Cranfield (England). Dept. of Materials.
THE TEMPERATURE DEPENDENCE OF PHOTO-ELASTIC PROPERTIES OF CROSS-LINKED AMORPHOUS POLYETHYLENES
D. W. Saunders, D. R. Lightfoot, and D. A. Parsons Aug. 1967 27 p refs
(COA-NOTE-MAT-11)

Cross-linked samples of polyethylene were prepared by electron irradiation of both high and low density polymers in the crystalline state. A further cross-linked sample was obtained by curing a high density polyethylene by reaction with dicumyl peroxide at 180°C. The stress–strain birefringence relations were obtained, on specimens cut from these samples, at temperatures between 130 and 250°C. All samples showed a substantial decrease in stress–optical coefficient with increasing degree of cross-linking and with increasing temperature. The stress–optical properties of each temperature were extrapolated to zero degree of cross-linking to give quantities characteristic of the Gaussian network. Comparison of these properties with Gaussian theory of the network leads to a value of ca.1150 cals/mole for the difference in energy between *trans* and *gauche* conformations of successive links of the polyethylene chain and also indicates that the optical anisotropy of a CH_2 group in the elastomeric state is more nearly given by Denbigh's than by Bunn and Daubeny's polarisabilities. Author

N68-10506* Uniroyal, Inc., Winnsboro, S. C. Research and Development Dept.
DEVELOPMENT OF NON-FLAMMABLE FABRIC CONSTRUCTIONS FOR SPACE FLIGHT
G. R. Cuthbertson and G. C. Holroyd 6 Nov. 1967 15 p
(Contract NAS9-7321)
(NASA-CR-65809) CSCL 11E

Flammability and flame impingement test data are provided on woven and stitch-bonded fabrics made of asbestos, Nomex, and glass filament yarn in various blends. The requirements for space capsule materials are listed as providing heat insulation so that when a flame at 1800°F is impinged on one face in an atmosphere of substantially pure oxygen at 16.5 psia, the temperature on the other face will not exceed 200°F after 30 seconds, or 300°F after five minutes. All samples tested were found adequate as regards flammability, and certain composite materials were able to attain the goal of a cool-face temperature of 200°F after 30 seconds. However, no single-layer material produced provided the desired degree of heat insulation. Indications are that no practical suiting can be made exclusively of the materials used in the fabrics which will reach the desired goal of a cool-face temperature of 300°F after five minutes. M.G.J.

N68-10541# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
MICROMECHANICS—EXPERIMENTAL AND ANALYTICAL STUDIES Final Report, May 1966–Apr. 1967
Victor G. Grinius Wright-Patterson AFB, Ohio AF Mater. Lab. Apr. 1967 105 p refs
(Contract AF 33(615)-1660)
(AFML-TR-148; AD-659166)

An investigation was made of the micromechanical behavior of a fiber reinforced composite under compressive, tensile, shear, and bending loads, along with repeated load cyclings. The results of these studies are published in Technical Reports AFML-TR-65-237 and AFML-TR-66-177. This work also included a general literature survey on micromechanics, which was published as AFML-TR-65-12. The objective of the third year of this program was to experimentally investigate the elastic constants and strength under tensile, compressive, shear, and bending loads for fiber reinforced composites having unidirectional and multidirectional layups, then to compare the experimental data with the existing methods for analytical predictions. The degree of correlation between analysis and experiment was determined. The program was conducted in five phases: specimen design, fabrication, experimental evaluation, analytical predictions, and comparison of experimental results to theoretical values. Author (TAB)

N68-10556# Sandia Corp., Albuquerque, N. Mex.
MECHANICAL PROPERTIES OF IMPACTED SOLID POLYURETHANE
B. M. Butcher Jul. 1967 10 p refs
(SC-RR-67-478) CFSTI: HC $3.00/MF $0.65

Plate impact experiments have been performed on 1.189 g/cc (solid) polyurethane to determine if visco-elastic effects can be detected within the velocity range of 0 to 1200 ft/sec. The results of the experiments indicate that deviations from anticipated behavior are small for the conditions investigated. Experimental techniques are described and data are presented in the form of stress–strain curves. Author (NSA)

N68-10580# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
OBSERVATIONS IN THE VITREOUS GERMANATE FLUORESCENCE REGION
H. D. Kivlighn, Jr. Nov. 1967 38 p refs
(RM-382)

Observations made during a compositional survey of the fluorescent germanate glass region are summarized. The glasses most promising for future examination as potential host matrices were found in the vitreous area of the $BaO–Al_2O_3–GeO_2$ system. The addition of a dopant species will undoubtedly be necessary, however, since all the fluorescent activity was broadband, with no trace of fine line emission in the fluorescent area. Although the goal of attaining a nondoped germanate glass with blue–green laser capabilities proved impracticable, the results of this study once again underscored the need for a comprehensive understanding of chemical bonding in the vitreous state. Author

N68-10801 National Bureau of Standards, Washington, D. C.
NUCLEAR SCIENCE AND TECHNOLOGY FOR CERAMISTS
Washington GPO 26 May 1967 76 p refs Proc. of the 68th Ann. Meeting of the Am. Ceramic Soc. held in Washington, D. C., 7–12 Apr. 1966
(NBS-Misc.-Publ.-285) GPO: $1.75

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N68-10802 National Bureau of Standards, Washington, D. C. Inst. for Materials Research.

MATERIAL RADIATION ENVIRONMENT

C. O. Muehlhause *In its* Nucl. Sci. and Technol. for Ceramists 26 May 1967 p 1–6 refs (See N68-10801 01-18)

Materials used in radiation systems are in general restricted by a wide variety of boundary conditions. For example, in reactor systems the materials are required not only to possess suitable nuclear properties, but also to display adequate stability against radiation damage. Ceramic materials are important in this technology. Radiation fields to which reactor materials are subjected are described, and principal physical effects induced by the radiation are identified. The elucidation of these effects by materials scientists and engineers is important not only to nuclear technology, but also to a general understanding of structure sensitivity of solids. Author

N68-10803 United Kingdom Atomic Energy Establishment, Harwell (England).

FUNDAMENTALS OF RADIATION DAMAGE IN CERAMICS

A. B. Lidiard *In* Natl. Bur. of Standards Nucl. Sci. and Technol. for Ceramists 26 May 1967 p 7–20 refs (See N68-10801 01-18)

Processes of radiation damage in ceramic materials of interest in nuclear technology are reviewed. These materials include those used as fuels (e.g. UO_2 solid solutions) as fuel coatings (e.g. SiC, Al_2O_3) and as moderators (e.g. graphite, BeO). Radiation damage in these materials consists firstly of the production of interstitial atoms and vacancies and, in fuels, of the introduction of foreign atoms notably the fission products. Secondly, at normal reactor temperatures the aggregation of these defects into clusters occurs and in non-cubic materials this leads to anisotropic changes in physical properties of the component, crystallites of which the most striking may be dimensional changes (e.g. in graphite). In fuels the growth of bubbles of fission gas can also lead to important dimensional changes. The theory of the growth of defect clusters is also described in relation to some of these problems. Author

N68-10804 Brookhaven National Lab., Upton, N. Y.

PHYSICAL PROPERTIES OF IRRADIATED CERAMIC MATERIALS

Paul W. Levy *In* Natl. Bur. of Standards Nucl. Sci. and Technol. for Ceramists 26 May 1967 p 21–32 refs (See N68-10801 01-18)

Materials are subjected to two principal types of radiation effects during reactor irradiation. First, there are ionization effects which result from electron and (electronic) hole movement and trapping. Second, there are displacement effects resulting from the movement of atoms. Reactor irradiation introduces vacancies, interstitials, and more complex defects consisting of combinations of these simple defects. Some of these act as charge traps. Numerous examples of radiation induced changes in the physical properties of ceramic materials can be cited. The most common phenomena associated with ionization effects is the coloring of glasses by irradiation. Displacement effects occur when atoms are ejected from their lattice sites by energetic electrons, gamma-rays, slow neutrons; fast neutrons (very efficiently); and, rarely, by other radiations. Almost all of the fast neutron damage is caused by energetic lattice atom recoils which are created by elastic collisions with fast neutrons. As the recoil passes through the lattice it produces numerous vacancies and interstitials along its trajectory. Both the ionization effects and the formation of individual point defects are illustrated by color center studies on very pure fused silica. The defect regions occurring along the trajectory of the lattice atom recoil can be related to changes in the low temperature thermal conductivity in single crystal Al_2O_3. The collective effect of numerous damage creating events, produced by long irradiations, result in a density decrease in crystal quartz and density increase in fused silica. In addition, the physical properties of materials are changed during irradiation. During bombardment the defect concentration is increased and this will, in turn, increase any defect-dependent diffusion processes. For example, the diffusion of Be in BeO is greatly accelerated during reactor irradiation. Author

N68-10805 Argonne National Lab., Ill.

CHEMICAL PROBLEMS ASSOCIATED WITH LATTICE-DEFECTS. URANIUM DIOXIDE PHASE

R. J. Thorn and G. H. Winslow *In* Natl. Bur. of Standards Nucl. Sci. and Technol. for Ceramists 26 May 1967 p 33–44 refs (See N68-10801 01-18)

Chemical problems associated with thermodynamic analyses of lattice defects for nonstoichiometric phases such as uranium dioxide are discussed. Considered are defects as chemical components, roles of valence states and their energies, the defect theory of nonstoichiometry, and kinetics at equilibrium (self-diffusion). S.C.W.

N68-10817# Furukawa Electric Co., Ltd., Tokyo (Japan).

FLAME RETARDANT CROSSLINKED POLYETHYLENE FOR WIRE AND CABLE

Tsunemi Yoshida, Reikichi Nakayama, and Tadaaki Kuhara [1967] 18 p refs Presented at the 16th Ann. Wire and Cable Symp., Atlantic City, N. J., 29–30 Nov.–1 Dec. 1967 (AD-659412)

The report relates to a flame retardant crosslinked polyethylene which was recently developed for use in insulating and jacketing electric wires and cables. It is widely known that by merely adding crosslinking agent to a conventional flame retardant polyethylene compound, several desirable properties cannot be attainable. Therefore, studies have been carried out on additives for fully effecting crosslink reaction, and additives for improving flame retardancy of the product. The new compound obtained through these studies not only possesses an excellent flame retardancy, which is evaluated in accordance with ASTM D-635 to be 'self-extinguishing' or 'non-burning', but it also has a high degree of crosslinking and outstanding electric characteristics. apparatus lead wires, drop wires and power cables insulated with this new compound have passed the vertical flame test by the UL method. The new compound is shown to have many outstanding practical properties. Author (TAB)

N68-10872# Westinghouse Electric Corp., Pittsburgh, Pa.

ACTIVATED SINTERING OF UO_2

Hanus Landspersky [1964] 26 p refs Transl. into ENGLISH from Jaderna Energie (Czechoslovakia), v. 12, no. 6, 1966 p 207–212 (WAPD-TRANS-58)

The effects of additions of Ca, Mg, Al, Ti, V, and Mo oxides on pressing and sintering characteristics of powdered UO_2 with

surface area > 10 m^2/g were compared. The additions were introduced into UO_2 either by their coprecipitation during the preparation of ammonium polyuranate or as additives to the mill. Additives introduced by means of coprecipitation did not influence pressing characteristics of UO_2, slight differences were found in the case of additives introduced by milling. Differences resulting from additions after four-hour-sintering were not found. Author (NSA)

N68-10927* IIT Research Inst., Chicago, Ill. Technology Center.
STUDY OF CORROSION INHIBITORS FOR APOLLO THERMAL TRANSPORT FLUIDS Final Report, Apr. 3–Jul. 17, 1967
David B. Boies and Barbara J. Northan 17 Jul. 1967 81 p ref
(Contract NAS9-6983)
(NASA-CR-65775; IITRI-U6063-2) CFSTI: $3.00 CSCL 11H

Corrosion inhibitors were screened for use in ethylene glycol/water thermal-transport fluids of the Apollo Environmental Control Systems and the Electric Power System. Both RS89a and uninhibited coolant fluid constitute a flammability hazard when in contact with defectively insulated silver-covered copper cable in DC circuits. The dominant factor is the presence of silver. Laboratory tests indicate that benzotriazole added to RS89a eliminates the flammability hazard. The use of a fluorescent dye, such as Rhodamine B, to detect coolant fluid leaks appears practical. Atpet 200 is promising as a corrosion inhibitor. The simulated ECS corrosion test loops were rebuilt for use in qualifying Rhodamine B dye and benzotriazole additions to glycol/water solutions for spacecraft fluids. Author

N68-11003* California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
MELTING OF SILICATES AT HIGH PRESSURE
Edgar A. Kraut, Ivan C. Getting, and George C. Kennedy [1968] 64 p refs *Its* Publ. 565
(Grant NsG-314)
(NASA-CR-90215) CSCL 11B

Melting temperatures of solids plotted versus pressures show curves of widely varying curvature. If the room temperature volume of the solid phases are also plotted against pressure, then one obtains curves of widely varying curvature but opposite in sign to that of the melting curve. This observation suggested the possibility that if melting temperatures, measured at different pressures, were to be plotted against the room temperature volumes of the solid phase, at these pressures, a straight line would be obtained. This hypothesis has been tested and found to hold for approximately 50 different elements and compounds to within the accuracy of the available experimental data, even when the pressure is great enough to double the density of the solid phase (Kraut and Kennedy, 1966). The relationship, however, apparently does not hold at low pressures for light elements and compounds for which certain quantum effects are important. As a result, an extremely simple melting equation which relates melting temperature T_m to the volume of the solid phase can be written. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-10028* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARTIAL STATIONARITY AS A COMPATIBILITY CRITERION FOR OVERDETERMINED SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS, RELATED TO NON-DIFFERENTIAL CONSTRAINTS
Edward M. Keberle 15 Nov. 1967 25 p refs
(Contract NAS7-100)
(NASA-CR-89926; JPL-TR-32-1101) CSCL 12A

Necessary and sufficient conditions (criterion of partial stationarity) are formulated for the existence and the eventual practical determination of initial values of all compatible selected solutions, which are related to a constraint system of ordinary differential equations. Presupposed are the expressions of the differential equations and the constraints only. Author

N68-10059# Wisconsin Univ., Madison. Dept. of Statistics.
MODELS FOR PREDICTION AND CONTROL IX DYNAMIC MODELS
G. E. P. Box and G. M. Jenkins (Lancaster Univ.) May 1967 32 p refs
(Grant AF-AFOSR-1158-66)
(TR-116; AD-656684)

In previous chapters we have considered the problem of representing practically occurring time series by linear stochastic difference equations. As a first example of the use of such models we have shown how they may be used for forecasting both non-seasonal and seasonal series. These series may also be used to represent disturbances such as arise in economics, engineering and in business applications. To control such systems we need not only an adequate disturbance model, but also a dynamic model which can take account of the various types of inertia which may be inherent in the process. The present chapter provides an introduction to models based on difference equations which give a parsimonious mathematical representation of the dynamic behaviour of physical systems. Two cases will be distinguished: (1) When the input to the system is kept fixed over constant intervals of time as in the discrete control systems, and, (2) When an essentially continuous input and output are sampled at equidistant time intervals and the resulting discrete time series used to estimate the dynamic response or transfer function of the system. TAB

N68-10121*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE RUNGE–KUTTA EQUATIONS BY QUADRATURE METHODS
Joseph S. Rosen Washington NASA Nov. 1967 16 p refs
(NASA-TR-R-275) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This report gives a basically new approach to the formulation of the classic Runge–Kutta process. Dependence on the tedious Taylor expansions is obviated by a matrix equation which defines the Runge–Kutta equations for any order; furthermore, the elements of these matrices are obtained quite simply. The method of quadratures is used to determine the conditions on the parameters which characterize the process since these parameters determine the order of accuracy of these functions. Author

N68-10155# Maryland Univ., College Park. Dept. of Physics and Astronomy.
SATURATION PROBLEM OF A SUM RULE OF SCALAR AND PSEUDOSCALAR SPECTRAL FUNCTIONS
C. H. Woo Jun. 1967 10 p refs
(Contract AF-AFOSR-500-66)
(TR-672; AFOSR-67-1617; AD-655516)

A sum rule of the scalar and pseudoscalar spectral functions is studied as a possible test for the commutation relations between the fourth component of the axial vector current and the scalar and pseudoscalar densities. Approximating the spectral functions by the one pion and two pion contributions, one finds the sum rule to be badly violated. Author (TAB)

N68-10249* Brown Univ., Providence, R. I. Center for Dynamical Systems.
THE CONCEPT OF INVARIANT SET FOR STOCHASTIC DYNAMICAL SYSTEMS, AND APPLICATIONS TO STOCHASTIC STABILITY

H. J. Kushner [1967] 22 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GK-967)
(NASA-CR-90093) CSCL 12A

Previously published stochastic Liapunov theorems, used in determining stability of Markov processes, are extended to include the notion of invariant set. It is felt that the result facilitates the application of the earlier work and strengthens the conclusion, analogous to the deterministic case. The proofs of the theorems and examples are given. N.E.N.

N68-10281# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
ON LINEAR ORDINARY DIFFERENTIAL EQUATIONS WITH EXPONENTIAL COEFFICIENTS
G. A. Hegemier Aug. 1967 28 p refs
(Contract N00014-67-A-0109-0003)
(TR-13; AD-659703)

A system of linear ordinary differential equations with exponential coefficients is considered; several theorems are presented concerning general solutions and their asymptotic forms for large values of the independent variable; elementary examples are given and applications cited to illustrate, and demonstrate the utility of, the solution forms obtained. The relevance of the results to the solution of problems of structural stability and wave propagation is briefly discussed. Author (TAB)

N68-10293# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
THE JOINT DISTRIBUTION OF THE VIRTUAL WAITINGTIME AND THE RESIDUAL BUSY PERIOD FOR THE M/G/1 QUEUE
Marcel F. Neuts Aug. 1967 16 p refs *Its* Mimeograph Ser. No. 116
(Contract Nonr-1100(26))
(AD-659062)

In the M/G/1 queue, the joint distribution of the virtual waitingtime and the residual duration of the busy period at any time T, is given by a formula analogous to the one for the virtual waitingtime by itself. In the limit, as T approaches limit of infinity, the limiting joint distribution is given by a formula of the Pollaczek–Khintchine type. Author (TAB)

N68-10355*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DETERMINATION OF STRESSES IN ELASTIC SOLIDS USING THREE STRESS FUNCTIONS AND THREE EQUATIONS
Robert E. Reed, Jr. Washington NASA Nov. 1967 43 p refs
(NASA-TN-D-4253) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The classical equations of elasticity in terms of the stress components are reduced to a set of three equations in terms of the three Maxwell stress functions and arbitrary functions of integration. The sufficiency of these equations is due to the interrelationships between the six compatibility equations. The difficulty in choosing the arbitrary functions to fit a particular problem accents the advantages of using the inverse method to find solutions. A family of exact solutions is presented for stresses in a rectangular solid with certain applied stresses on two opposite faces, workless boundary conditions on two opposite faces, and the remaining two faces free of applied stress. Author

N68-10472# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
ASYMPTOTIC FORMULAS FOR INITIAL-VALUE PROBLEMS OF NON-LINEAR DIFFERENTIAL EQUATIONS WITH A SMALL PARAMETER MULTIPLYING THE DERIVATIVE
Donald B. McMillan (Ph.D. Thesis—Rensselaer Polytech. Inst.) 1 Aug. 1967 55 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-3359) CFSTI: HC $3.00/MF $0.65

Asymptotic methods for the approximate solution of systems of ordinary differential equations in which some of the variables have very short response times on the time scale of the interesting behavior of the system are given. Systems of this kind arise in various application areas. In particular, the reactor kinetics equations are such a system. The approximating differential equations described may be solved numerically at reasonable time steps in terms of the interesting behavior of the system. Author (NSA)

N68-10473# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
SNEQ: A COMBINATION OF PROGRAMS TO PLOT CURVES AND/OR SOLVE NONLINEAR ALGEBRAIC EQUATIONS
G. L. Lechliter 30 May 1967 35 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6709) CFSTI: HC $3.00/MF $0.65

Two computer programs that can be used in conjunction with the SLIP compiler for solving and/or displaying input equations are described. The two programs presented are: SNAP—a program to solve nonlinear, algebriac equations, and EQPLT—a program that reads equations as input and plots the results. This is extremely useful for parameter studies. Also, since these two programs both use the SLIP compiler, they have been combined and are both callable from within a single run. These programs are written in the FORTRAN-IV language. The approximate running time for a typical problem is 2 seconds. Author (NSA)

N68-10478# Oak Ridge National Lab., Tenn.
A PROBABILITY DISTRIBUTION ARISING IN A RIFF-SHUFFLE
V. R. Rao Uppuluri and W. J. Blot Sep. 1967 33 p refs
(Contract W-7405-ENG-26)
(ORNL-4156) CFSTI: HC $3.00/MF $0.65

A discrete random variable X=0, 1, 3, ..., m-1, with probability density function $\binom{m+x-1}{x}(p^m q^x + q^m p^x)$, $p>0$, $p+q=1$, has arisen during the study of riff-shuffles as a Markov Process. An expression for the moment generating function of this variable is obtained, from which the mean and variance are derived. By equating two different expressions for the mean of the variable, a closed form for the incomplete beta function with equal arguments is obtained as $I_{pq}(m,m) = p + (p-q)\sum_{k=1}^{m-1}\binom{2k-1}{k}(pq)^k$. It is shown how this expression helps for the rapid computation of the incomplete beta function with integral arguments. This expression is also used in deriving the asymptotic (m-large) expressions for the mean and variance. The standardized variate is shown to converge to the Gaussian distribution as $m \to \infty$. A result corresponding to the DeMoivre–Laplace type theorem is proved for m sufficiently large. Finally, applications are indicated to the genetic code problem, to Banach's match box problem and to the World Series of baseball. Author (NSA)

N68-10534# Naval Ship Research and Development Center, Washington, D. C. Applied Mathematics Lab.
GENERALIZED COVARIANCES AND POWER SPECTRA FOR DISCRETE TIME SERIES
R. P. Eddy Jun. 1967 31 p refs
(NSRDC-2413; AD-659183)

The object of the work presented here is to develop refined tools for characterizing discrete time series of finite duration. A fundamental assumption (certainly not unfamiliar) of periodicity is made so that the underlying time domain becomes a group in the mathematical sense. Group properties of this time domain, the additive group of integers modulo N, are used to motivate and unify the theory. For any complex valued function defined on the group, the usual autocovariance function of a single time variable

is set up and then generalized to a family of functions of several time variables. The coefficients in the expansions of these functions in terms of the group characters are called the generalized power spectra. The latter can be simply expressed in terms of fourier moments which are finite fourier transforms of powers of the given function of time. Also considered are the generalizations of these concepts to the case of several simultaneous time series. TAB

N68-10590# California Univ., Berkeley. Operations Research Center.
PROJECTIONS OF CONVEX POLYHEDRAL SETS
David A. Kohler Aug. 1967 54 p refs
(Contract Nonr-222(83); Grant NSF GK-1684)
(ORC-67-29; AD-659301)

The main problem considered is: Given a set of linear inequalities (1.1) Ax + By = or > d, which defines a set of (x;y), find and concisely define a set Y of y such that if (x;y) solves (1.1) then y belongs to Y and, conversely, if y belongs to Y then there exists an x such that (x;y) solves (1.1). The solution to this problem involves finding the set of all extreme rays of the convex cone wA = 0, w = or 0 and a method is given for this. The method is compared with other methods for finding extreme rays and points and finally some practical applications are given. Author (TAB)

N68-10597# Brookhaven National Lab., Upton, N. Y. Applied Mathematics Dept.
SOLUTION OF PROGRAMMING PROBLEMS BY GENERATING FUNCTIONS
James K. Thurber 1967 73 p refs Presented at Intern. Symp. on Math. Programming, Princeton, N. J.
(BNL-11676; CONF-670817-1) CFSTI: HC$3.00/MF$0.65

A method has been developed for solving integer programming problems by using generating functions. By means of the generating functions the feasible solutions for a system with linear constraints can be represented in terms of new sets of integer variables which satisfy only the trivial constraints that they be nonnegative. The minimization problem then becomes a triviality in principle although in practice it may lead to a tedious computation. Examples are included where both situations occur (i.e., where the method gives quick solutions and where it is impractical). The procedure is based on an extension and simplification of some ideas of P. A. MacMahon on the theory of partitions. In addition the method leads to some results in multiplicative number theory, greatly generalizing some well known identities involving the Riemann zeta function. The algorithm also has a continuous analog which amounts to solving simultaneous linear inequalities by means of Laplace transforms. The representation of the feasible solutions by means of Laplace transforms also eliminates all the non-trivial constraints and permits the minimization problem to be dealt with via classical methods of the calculus for non-linear objective functions and reduces the case of linear objective functions to a trivial although possibly tedious computation. Author (NSA)

N68-10642# Cornell Univ., Ithaca, N. Y. Dept. of Operations Research.
DIFFUSION APPROXIMATIONS IN APPLIED PROBABILITY
Donald L. Iglehart Jul. 1967 31 p refs Presented at Am. Mathematical Soc. 1967 Summer Seminar on Math. of the Decision Sci., Stanford, Calif., Jul. 19–Aug. 11, 1967
(Contract Nonr-401(55))
(TR-28; AD-659486)

This is an expository paper which discusses numerous methods for obtaining diffusion approximations for models in applied probability. For many such models it is difficult to obtain explicit expressions for the distributions of random quantities of interest. In some problems, however, approximations can be obtained from limit theorems as a particular physical parameter approaches a limit. Examples of such physical parameters are the traffic intensity and the number of servers in queueing models, the number of balls in various urn models, and the probability of breakdown in a quality control model. In general, the objective is to obtain limit theorems (in the sense of weak convergence of measures) for a sequence of stochastic processes. Often the limit process is a well-known diffusion process. This diffusion process then yields approximations in the same manner as does the central limit theorem. Author (TAB)

N68-10656# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
MULTICHANNEL VARIATIONAL SPACE–TIME SYNTHESIS WITH DISCONTINUOUS EXPANSION FUNCTIONS
Weston M. Stacey, Jr. 27 Jun. 1967 25 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6711) CFSTI: HC$3.00/MF$0.65

Multichannel space–time synthesis equations have been derived from a variational principle for the time-integrated P_1 equations. Discontinuous expansion functions are admitted in the formalism. Author (NSA)

N68-10657# California Univ., Berkeley. Lawrence Radiation Lab.
TABLE OF THE SOLUTIONS OF a tan(πx) = −b tan(aπx)
Paul Concus 2 Jun. 1967 6 p ref
(Contract W-7405-ENG-48)
(UCRL-17608) CFSTI: HC$3.00/MF$0.65

The first ten positive values of x satisfying a tan(πx) = −b tan(aπx) are given to four places for several values of a and b in the range $0.001 \leq a \leq 1.0$ and $0.001 \leq b \leq 1000$. Author (NSA)

N68-10692# North Carolina Univ., Chapel Hill. Dept. of Statistics.
BRANCHING PROCESSES IN STOCHASTIC ENVIRONMENTS
William E. Wilkinson Sep. 1967 79 p refs
(Contract Nonr-855(09))
(Rept.-544; AD-659066)

This paper is concerned with two simple models for branching processes in stochastic environments. The models are identical to the model for the classical Galton-Watson branching process in all respects but one. In the family-tree language commonly used to describe branching processes, that difference is that the probability distribution for the number of offspring of an object changes stochastically from one generation to the next, and is the same for all members of the same generation. That is, the probability distribution of the number of offspring is a function of the environment. The two models considered herein have a random environment and a Markov environment. The object of study is the probability distribution of the number of objects Zn in the nth generation. Of particular interest is the determination of conditions under which the family has probability one of dying out. TAB

N68-10730# Los Alamos Scientific Lab., N. Mex.
EXPERIMENTS ON ERROR GROWTH ASSOCIATED WITH SOME LINEAR LEAST-SQUARES PROCEDURES
T. L. Jordan 18 Aug. 1967 9 p refs
(Contract W-7405-ENG-36)
(LA-3717) CFSTI: HC$3.00/MF$0.65

Some numerical experiments were performed to compare the performance of procedures for solving the linear least-squares problem based on Gram–Schmidt, Modified Gram–Schmidt, and Householder tranformations, as well as the classical method of forming and solving the normal equations. In addition, similar comparisons were made of the first three procedures and a procedure based on Gaussian elimination for solving an n×n system of equations. The results of these experiments suggest that: the Modified Gram–Schmidt procedure is best for the least-squares problem and that the procedure based on Householder

transformations performed competively; all the methods for solving least-squares problems suffer the effects of the condition number of ATA, although in a different manner for the first three procedures than for the fourth; and the procedure based on Gaussian elimination is the most economical and essentially the most accurate for solving nXn systems of linear equations. Some effects of pivoting in each of the procedures are included. Author (NSA)

N68-10859# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
EXISTENCE–UNIQUENESS THEOREMS FOR NON-LINEAR DIRICHLET PROBLEMS
Dale W. Lick 23 Aug. 1967 9 p ref
(Contract W-7405-ENG-26)
(K-1723) CFSTI: HC $3.00/MF $0.65

Existence–uniqueness theorems are proved for the Dirichlet problems for the nonlinear equations $\nabla^2 u - [c_1 u/(1 + c_2 u)] = 0$, $u \geq 0$, $\nabla^2 u + [c_1/(1 + c_2 u)] = 0$, $u \geq 0$, and $\nabla^2 u - f(u) = 0$, $u \geq 0$ with boundary condition $u = \phi \geq 0$. Author (NSA)

N68-10980# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
TWO QUEUES IN SERIES WITH A FINITE, INTERMEDIATE WAITINGROOM
Marcel F. Neuts Jun. 1967 32 p refs *Its* Mimeograph Ser. No. 110
(Contract Nonr-1100(26))
(AD-656483)

A service unit I, with Poisson input and general service times is in series with a unit II, with negative-exponential service times. The intermediate waitingroom can accommodate at most k persons and a customer cannot leave unit I when the waitingroom is full. It is shown that this system of queues can be studied in terms of an imbedded semi-Markov process. Equations for the time dependent distributions are given, but the main emphasis is on the equilibrium conditions and on asymptotic results. Author

N68-10992# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON SELECTION AND RANKING PROCEDURES
Shanti S. Gupta Aug. 1967 5 p refs *Its* Mimeograph Ser. No. 119
(Contract F33615-67-C-1244)
(AD-659073)

This paper describes some parametric procedures for selecting a subset containing the best population. Properties of selection rules for the location and scale parameter cases are mentioned. Brief tables giving the constants that define the selection procedures for the means and variances of normal populations are given. Also a brief table relevant to efficiency of the means procedure is given. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-10019# Texas Univ., Austin. Electrical Engineering Research Lab.
REPORT OF BISTATIC RADAR EXPERIMENT DESIGNED TO MEASURE THE IN-CLOUD DROP SIZE DISTRIBUTION FUNCTION
Alfred H. La Grone 24 Jul. 1967 35 p refs
(Contract DA-49-092-ARO-87)
(P-18; AD-658230)

Facilities for determining the orthogonal components of the angle scattered signal and the backscattered signal of reflections from hydrometers for a vertically looking radar operating an X-band were developed. Meteorological instruments such as tipping bucket rain gages, anemometer, thermometer, and drop size distribution counter were employed for surface control. Measurements were made on a number of rain showers and were analyzed. Excellent agreement was found between the amplitude of the bistatic radar signals, both E subscript theta and E subscript phi, and the rain rate determined by the tipping bucket rain gages. The drop size distribution meter indicated distribution functions that were in close agreement with a two parameter distribution proposed by Marshall-Palmer. Author (TAB)

N68-10034 National Severe Storms Lab., Norman, Okla. Inst. for Atmospheric Sciences.
A THEORY FOR THE DETERMINATION OF WIND AND PRECIPITATION VELOCITIES WITH DOPPLER RADARS
Larry Armijo (TRW Systems, Houston, Tex.) Aug. 1967 27 p refs
(NSSL-35)

The feasibility of determining components of wind velocity and precipitation particle terminal fall speeds from the equation of continuity for air and precipitation velocity data collected by Doppler radars is investigated. The investigation is carried out for a system which utilizes two Doppler radars as well as for a system which utilizes three noncolinear Doppler radars. When only two Doppler radars are available, it is necessary to assume that the terminal fall speed of precipitation particles is known. This assumption is unnecessary when the data of three noncolinear Doppler radars are available. For suitably restricted precipitation regions, the problems are shown to be well-posed in the mathematical sense and explicit representations of the solutions are obtained. Author

N68-10045# Weather Bureau, Asheville, N. C. National Weather Records Center.
U.S. NAVAL WEATHER SERVICE WORLD-WIDE AIRFIELD SUMMARIES. VOLUME I: SOUTHEAST ASIA
Jun. 1967 491 p
(AD-656092)

The volume is the first of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. The summaries were prepared by the U. S. Air Force, Air Weather Service, and were provided in the form of magnetic tape. These are being compiled in book form, by country or geographical area, for promulgation to Naval Weather Service units. Author (TAB)

N68-10064# Bureau of Meteorology, Melbourne (Australia).
SELECTED SURFACE CLIMATIC DATA FOR ANTARCTIC STATIONS
H. R. Phillpot, comp. Jul. 1967 118 p refs
CFSTI: HC $3.00/MF $0.65

A study is being made of the synoptic climatology of the Antarctic, defined as the area south of lat. 50°S. Data from a large number of stations, particularly from those with reasonably long periods of record, have been collected and arrayed in a series of tables. A list of the stations shows the station altitude, latitude and longitude, together with the appropriate Table and page number for the climatic data. Results for Marion and Kerguelen Islands have also been included although these are a little north of lat. 50°. Author

N68-10096# RAND Corp., Santa Monica, Calif.
ICE MULTIPLICATION IN THE ATMOSPHERE

L. Randall Koenig Aug. 1967 25 p refs Presented at the Nucleation Conf. of the Bur. of Reclamation, Denver, 10–12 Jul. 1967
(P-3623; AD-657750)

Data on the composition of unpolluted, unseeded stratocumulus and nimbostratus clouds having temperatures warmer than -9C reveal, in some instances, high concentrations of ice particles (to approximately 400 per liter of cloud). On the basis of measurements of the concentration of ice-forming nuclei reported in the literature, and the activation temperature of particles believed to be natural atmospheric ice nuclei, it is concluded that some multiplication process was responsible for the observed concentrations of ice particles. Since moderately large drops were present in the glaciating clouds, the data are consistent with a process whereby drops are frozen and splintered; however, in view of other evidence casting doubt on the validity of this process in the free atmosphere, alternative hypotheses are examined. Freezing of drops by a stochastic process is untenable, but a mechanical fracturing process seems possible and merits additional study. Author (TAB)

N68-10215# Environmental Science Services Administration, Silver Spring, Md. National Meteorological Center.
WEEKLY SYNOPTIC ANALYSES, 5-, 2-, AND 0.4-MB. SURFACES FOR 1965 (BASED ON OBSERVATIONS OF THE METEOROLOGICAL ROCKET NETWORK DURING THE IQSY)
Aug. 1967 177 p
(WB-3) CFSTI: $3.00

Data from the Meteorological Rocket Network and other sources, in addition to high-level rawinsonde observations, have been employed to analyze a series of 5-, 2-, and 0.4-mb charts. Methods employed for processing the various types of data as well as the analysis procedure are described. The broadscale analyses, primarily covering the North American and adjacent ocean areas, are presented for each week of 1965, the second year of the International Years of the Quiet Sun period. A brief discussion of the circulation and temperature patterns in the middle and upper stratosphere as indicated by the charts is also presented. Author

N68-10222* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN EVALUATION OF SEA SURFACE TEMPERATURE AS MEASURED BY THE NIMBUS I HIGH RESOLUTION INFRARED RADIOMETER
Lewis J. Allison and James S. Kennedy (USAF) Washington NASA Nov. 1967 27 p refs
(NASA-TN-D-4078) CFSTI: $3.00 CSCL 04B

An analysis of Nimbus I HRIR data over various parts of the world indicated limited success in deriving sea surface temperatures to within 3° to 6°K of aircraft radiation measurements (8-13μ) and synoptic-climatological ship sea surface temperature data. At night, thin clouds which may fill the radiometer's field of view make it difficult to interpret the absolute values of derived sea surface temperature. During the daytime, the HRIR data is unusable for oceanographic temperature analysis because the contamination by reflected solar radiation mixes with the emitted radiation. Future satellite instrumentation, consisting of a HRIR radiometer (10–11μ) when used in conjunction with television data, will delineate cloud free ocean areas and permit the daily derivation of sea surface temperatures from approximately 10 to 30% of the world's oceanic regions. Author

N68-10245# Pennsylvania State Univ., University Park.
PROPERTIES OF WIND AND TEMPERATURE AT ROUND HILL, SOUTH DARTMOUTH, MASS. Final Report, 15 Jul. 1966–14 Jul. 1967
Hans A. Panofsky, Niels E. Busch, B. Prasad, Steven R. Hanna, Ernest W. Peterson et al Aug. 1967 110 p refs
(Contract DAAB-07-67-C-0035)
(RCS-OSD-1366; ECOM-0035-F; AD-659430)

The unusually complete low-level meteorological data at South Dartmouth, Mass. have been analyzed. The results confirm isotropy at high frequencies, show that spectra and cospectra can be estimated by numerical similarity-type expressions, and that the nondimensional wind shear in accelerating air is significantly less than that in air in equilibrium. Estimation procedures for fluctuation statistics are developed. Author (TAB)

N68-10409 Environmental Science Services Administration, Atlantic City, N. J. Test and Evaluation Lab.
TEST USE OF MESONET DATA IN MANUAL FORECAST PREPARATION Final Report
Matthew Lefkowitz and David L. McLaughlin Sep. 1967 28 p
(Contract FA-65-WAI-126)
(SRDS-RD-67-66)

Aviation forecasters on a test basis have prepared short-range terminal weather forecasts with and without the use of special mesoscale data. The purposes of the test were to develop mesoscale forecast techniques, compare the manually prepared forecasts with computer generated techniques, and to assess the utility of the mesonet for improvement of terminal weather predictions. The overall participation by the Weather Bureau and the reactions of the test forecasters are summarized. Difficulties were noted by the test forecasters in using mesoscale data after extensive previous experience only at the macroscale level. This, coupled with unfamiliarity with weather sensor responses as they relate to observations, limited the development of new mesoscale forecast techniques. Author

N68-10501# National Academy of Sciences—National Research Council, Washington, D. C. World Data Center A.
METEOROLOGICAL ROCKET NETWORK FIRINGS Data Report
Asheville, N. C., Natl. Weather Records Center, Mar. 1967 231 p ref *Its* V. 4, No. 3
CFSTI: HC $3.00/MF $0.65

Wind and temperature measurements from all available meteorological sounding rocket firings are tabulated, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are also given. A brief monthly summary is included which compares the mean profile for the current month with long-term means for the same month. E.C.

N68-10899 Joint Publications Research Service, Washington, D. C.
THE SOVIET "METEOR" SPACE SYSTEM
I. Vetlov 8 Nov. 1967 12 p refs Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 9, 1967 p 31–35
CFSTI: $3.00

The Meteor system serves to collect meteorological information for normal weather service and scientific research. The system includes the satellites Cosmos 122, 144, and 156, points for the reception, processing, and dissemination of meteorological information, and facilities for control of the satellites and their onboard systems. This paper briefly describes the development of the system, scientific instrumentation of the satellites, stabilization and control mechanisms, power devices, and servo equipment. K.W.

N68-10991 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
FIFTH METEOROLOGICAL YEARBOOK OF THE CASACCIA CENTER FOR NUCLEAR STUDIES, 1966 [V ANNUARIO METEOROLOGICO DEL CENTRO DI STUDI NUCLEARI DELLA CASACCIA, 1966]
1967 125 p In ITALIAN
(RT/PROT(67)13)

Meteorological data collected between December 1, 1965, and November 30, 1966, are tabulated; and various graphs are included to depict atmospheric conditions in the vicinity of Rome. Measurements include humidity, precipitation, temperature, and wind velocity; and general climatological profiles are discussed. Transl. by M.W.R.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-10048*# International Information, Inc., Philadelphia, Pa.
THE MECHANICAL FUNDAMENTALS AND APPLICATIONAL MODES OF INERTIAL NAVIGATION [LES FONDEMENTS MECANIQUES ET LES FORMES D'APPLICATION DE LA NAVIGATION PAR INERTIE]
Pierre Contensou Washington NASA Nov. 1967 32 p refs Transl. into ENGLISH of ONERA Rept. TP-352 Presented at 1966 Session of the Assoc. Tech. Maritime et Aeron., Paris, 2–6 May, 1966
(Contract NASw-1499)
(NASA-TT-F-10667) CFSTI: $3.00 CSCL 17G

The author has undertaken in a very general form an exposition of the principles of rational mechanics which constitute the basis of inertial navigation. He has shown how closely the accuracy characteristic of this form of navigation is linked with the structure of the gravitational field in which the vehicle moves. Applications to ballistic missile guidance, aircraft and ship detection, and space mission control are discussed briefly in the light of general principles, with a detailed technical description avoided. Author

N68-10349# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IDEAS OF THE INVARIANCE THEORY AND INERTIAL NAVIGATIONS [IDEI TEORII INVARIANTNOSTI I INERTSIAL'NAYA NAVIGATSIYA]
A. Yu. Ishlinskiy 18 Aug. 1967 23 p refs Transl. into ENGLISH from Izd. Nauka (Moscow), 1964 p 56–64
(FTD-MT-67-69; TT-67-62999; AD-659316)

The article reviews the basic concepts of the theory of invariance as pertains to automatic control systems, that is, systems in which perturbations impinging on the system are automatically compensated for. The basic ideas are illustrated using the case of a pendulum, both neglecting and considering the curvature of the Earth. This example is then applied to the problem of inertial navigation of a satellite. The object in the figure is assumed to be traveling along a great circle of the Earth. From the point of view of the theory of invariance, the compensating force is shown to be M(t). Various applications of the solution of the gyroscopic control problem to orbiting objects are then presented.
Author (TAB)

N68-10828# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROCKET CONTROL
V. P. Petrov and A. A. Sochivko 20 Apr. 1967 217 p refs Transl. into ENGLISH of the book "Upravleniye Raketami" Moscow, Voyennoye Izdatel'stvo, 1963 p 1–264
(FTD-MT-65-248; AD-659661)

The book outlines the physical principles of rocket weapon control. Basic information from jet propulsion theory is given, and the most common rocket guidance systems described in the non-Soviet press are considered. TAB

N68-10829# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIO SIGNALS USED TO CONTROL MISSILES [RADIOSIGNALY UPRAVLYAYUT SNARYADAMI]
F. Chestnov 18 Apr. 1967 12 p Transl. into ENGLISH from Voyennyye Znaniya, no. 10, 1964 p 32–33
(FTD-HT-66-486; AD-659663)

The article is a popularized account of the foreign press information on radio-controlled guided missiles. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-10016# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
RADIOLYTIC GAS PRODUCTION IN LIQUID CONTROL ELEMENTS FOR NUCLEAR REACTORS USING BORON AS THE ABSORBER
W. D. Mackintosh, J. A. Atherley, and P. J. Dyne Apr. 1967 42 p refs
(AECL-2670; CRCE-1257) CFSTI: HC $3.00/MF $0.65

Any design proposal for the concept of liquid control elements using boron solutions as the absorber must take cognizance of the radiolytic gas production. The gas production will be greater than would be given by pure water because of the absorption of α particle and ^{7}Li recoil energy derived from the $^{10}B(n-\alpha)^{7}Li$ nuclear reaction. The radiolytic gas production rate is known for irradiations carried out in sealed quartz capsules. The experiments in which boron solutions were irradiated in the moderator Chemistry Loop (X-8) of NRX which simulates and actual operating device are described. It was found that the values obtained for the concentrations of the molecular products of radiolysis could be correlated with computer calculations based on a model which was derived from established concepts of the radiation chemistry of aqueous solutions. The model was then used to calculate the radiolytic gas pressure and evolution rates for B concentrations greater than could be accommodated in the loop. Author (NSA)

N68-10050*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
COMPARISON OF LOAD BEARING AND NON-LOAD BEARING RADIATORS FOR NUCLEAR RANKINE SYSTEMS
R. D. Cockfield 6 May 1967 98 p refs
(Contract NASw-1449)
(NASA-CR-72307; GE-ANSO-6300-203) CFSTI: HC $3.00/MF $0.65 CSCL 18N

A comparison is made between load bearing radiators in a conical configuration, and nonload bearing radiators in a flat panel configuration, for a nuclear potassium Rankine powerplant. For a typical unmanned interplanetary probe mission the load bearing radiator showed a payload advantage of four percent at a power level of 300 kWe, and an advantage of thirty percent at 1200 kWe. The comparison shows that the nonload bearing radiator does not achieve the payload advantage for interplanetary missions that might be anticipated by virtue of its ability to dispose of launch structure.
Author

N68-10124# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
A NOTE ON THE SHAPE OF THE FISSION PEAK IN HYDROGEN MODERATED REACTORS
R. A. Reiter May 1967 9 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6714) CFSTI: HC$3.00/MF$0.65

Simple calculations have been performed to demonstrate the effects of some physical parameters on the shape of the "fission peak" in the neutron spectrum. The shape of the high energy side of the peak is found to depend strongly on the fission spectrum and on inelastic scattering while the low energy side depends almost entirely on the hydrogen scattering cross section.
Author (NSA)

N68-10126# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ENRICHED URANIUM-METAL MEASUREMENTS, NO. 1
Grover Tuck 26 Jul. 1967 38 p refs
(Contract AT(29-1)-1106)
(RFP-907) CFSTI: HC$3.00/MF$0.65

The critical masses of oil-reflected and moderated enriched uranium (93.12% uranium-235) spherical and hemispherical shell assemblies have been measured at inside radii of 0, 4, 6.67, 8 and 12 centimeters (cm). The measurements are described and compared to calculated values for spherical assemblies.
Author (NSA)

N68-10133*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHIELDING REQUIREMENTS FOR THE NASA PLUM BROOK HB-6 BEAMHOLE RADIATION EFFECTS FACILITY
Harvey S. Bloomfield Washington NASA Nov. 1967 23 p refs
(NASA-TM-X-1461) CFSTI: HC$3.00/MF$0.65 CSCL 18F

The calculational methods and results used to design a shield assembly for the Plum Brook Reactor HB-6 beamhole facility are described. The function of this shield assembly is to provide adequate biological protection during reactor operation and to permit personnel access to a test chamber after shutdown. Radiation sources examined during reactor operation were neutrons and gamma rays scattered by an experimental package in the test chamber, direct core radiations, and radiation through rectangular slits which may be formed by misalinement of shield sections. Fission product decay gammas and neutron-induced gamma activity in the test chamber were the important radiation sources investigated after shutdown. The bulk of the calculations was performed by specialized digital computer shielding programs which accounted for considerable detail of the core-beamhole geometry. Calculational results compare favorably with experimental measurements on the final shield assembly.
Author

N68-10134*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND OPERATION OF A HIGH-TEMPERATURE TUNGSTEN-MESH GAS HEATER
Byron L. Siegel Washington, NASA Nov. 1967 26 p refs
(NASA-TM-X-1466) CFSTI: HC$3.00/MF$0.65 CSCL 18I

A high-temperature electrically heated gas heater was designed and is operational. This heater uses interwound helical tungsten coils as mesh heating elements. The heater has heated 0.450 and 0.69 pound per second of nitrogen to 4530° and 4200°R with average mesh bank surface temperatures as high as 4430° and 4270°R respectively. The design of the heater is described and its advantages are discussed. Problem areas associated with the design of a high-temperature heater, such as flow bypass, are described, and resulting solutions or recommendations are given.
Author

N68-10217# California Univ., Livermore. Lawrence Radiation Lab.
PRELIMINARY THOUGHTS ON REACTOR OPTIMIZATION CRITERIA
Norman Brown 7 Jul. 1967 18 p ref *Its* Space Power Note No. 225
(UCID-15168) CFSTI: HC$3.00/MF$0.65

The selection of the optimum fuel element configurations for reactors covering the range from 1 to 100 Mw is examined briefly, and a few preliminary criteria are established for a first approximation.
Author (NSA)

N68-10291*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF ABSOLUTE CALCULATED AND MEASURED GAMMA AND NEUTRON DOSES IN TUNGSTEN–WATER-MODERATED CRITICAL ASSEMBLY
Paul G. Klann and Walter A. Paulson Washington NASA Nov. 1967 55 p refs
(NASA-TN-D-4223) CFSTI: HC$3.00/MF$0.65 CSCL 18E

The mixed gamma and neutron dose was measured at 60 locations within the Tungsten–Water-Moderated Reactor critical assembly. Graphite wall thimble ionization chambers filled with carbon dioxide and polyethylene wall chambers filled with ethylene were used. The chambers were absolutely calibrated in a bremsstrahlung beam against a secondary calibration standard and in a reactor against a water filled calorimeter. These calibrations were used to obtain gamma and neutron response coefficients for the chambers which permitted partitioning of the measured mixed radiation dose into a gamma dose and a neutron dose. The measured gamma doses were compared with an Athena Monte Carlo calculation. Good agreement was found for the 16 locations compared. The average deviation was 10 percent. In addition, the measured neutron doses were compared with a "first collision" calculation of the dose. The calculated neutron doses were uniformly low with an average deviation from the measurement of 18 percent.
Author

N68-10374 Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England).
SOME ASPECTS OF MATERIALS TECHNOLOGY OF IMPORTANCE TO THE DEVELOPMENT OF NUCLEAR REACTORS
R. W. Nichols and J. H. Gittus 1967 31 p refs
(TRG-1516(E)) CFSTI: $3.00

Several aspects of the development of metallic materials for use in the British nuclear power program are discussed. The effects of irradiation and corrosion on structural materials in the Advanced Gas-cooled Reactor and the High Temperature Gas-cooled

Reactor are described, with particular mention of the influence of resistance to corrosion on the selection of materials for heat exchanger tubing and for thermal insulation foils. Corrosion resistance was also important in the selection of a cladding material for the A.G.R. but recent work has been concerned with increasing its ductility under tube-burst and cyclic strain conditions. A major program of experiments involving a statistical examination of this problem has highlighted the advantages accruing from use of a fine metallurgical grain size. With respect to the Steam Generating Heavy Water reactor, mention is made of the assessment of zirconium alloy pressure tubes for hydrogen and irradiation embrittlement and a technique based on measuring the critical crack opening displacement is described which may be of general value for assessing fracture toughness in relation to of general value for assessing fracture toughness in relation to engineering designs. Mention is made of several aspects of the corrosion and mass transfer of metals in liquid sodium; the similarity in behaviour of a wide range of different steels is noted. There are, however, considerable differences in the rates of carbon transfer from different steels in sodium, and it is necessary in selecting steels for use in a sodium-cooled fast reactor to choose those with suitable alloying additions to resist decarburisation. Some aspects of the effect of neutron irradiation in reducing the high-temperature ductility of austenitic steels and nickel alloys are mentioned and the importance of controlling the grain size and precipitate distribution in such materials is indicated. Author

N68-10425 United Kingdom Atomic Energy Authority, Windscale (England). Reactor Development Lab.

THE EXAMINATION OF BULK-IRRADIATED URANIUM DIOXIDE BY TRANSMISSION ELECTRON MICROSCOPY

A. J. Manley 1967 30 p ref

(TRG-1478(W)) CFSTI: $3.00

Thin foils have been successfully prepared from irradiated UO_2 in the burn-up range 800–4900 MWd/te and temperature range 800–2200°C. Examination by transmission electron microscopy revealed dislocation loops, black dots, and tangled dislocations in normal-grained regions. Helical dislocations and large precipitates were found in regions of equi-axed grain growth. Three structures were found in columnar grained regions, representing early stages of irradiation damage and consistent with the theory of formation of columnar grains. Surface contamination, in the form of small particles, appeared to come from the foils themselves. Some of these were tentatively identified as URu_3, while others appear to be a mixture of unknown phases (possibly fission products). Gas bubbles found in the as-irradiated foils did not account for all the fission gases, but beam annealing caused precipitation of bubbles apparently containing too much gas. Gas bubbles were often found associated with black dots, which apparently both act as nuclei and pin their movement. One measurement of gas-bubble movement indicated a surface diffusion process. The planes of two geometrically shaped loops were identified as (211) and one elliptical loop on (100). The stacking faults found in one beam-annealed foil were not on (111) but appeared to be on (511). Author

N68-10429* Space Technology Labs., Inc., Redondo Beach, Calif.

MISSION ORIENTED ADVANCED NUCLEAR SYSTEM PARAMETERS STUDY, VOLUME III: PARAMETRIC MISSION PERFORMANCE DATA Final Report

A. R. Chovit, C. D. Kylstra, and R. D. Fiscus Mar. 1965 461 p

(Contract NAS8-5371)

(NASA-CR-89985; STL-8423-6007-RU-000, Vol. III) CSCL 21F

The results obtained from a comprehensive, parametric lunar and interplanetary mission analysis are presented. The results are primarily presented as the minimum gross vehicle weight in earth orbit versus various missions, vehicle configurations, or propulsion system performance parameters. These results were generated over 20,000 mission simulations performed on the IBM 7094 with the optimum trajectory and vehicle determined for each simulation. The definitions, scaling laws, constraints, and criteria used in these computations are given. Author

N68-10434# Oak Ridge National Lab., Tenn.

A SIMPLIFIED APPROACH TO CALCULATING CONVECTIVE PLATEOUT OF FISSION PRODUCTS

T. S. Kress and F. H. Neill [1966] 4 p refs Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago

(Contract W-7405-ENG-26)

(ORNL-P-3205; CONF-671102-9) CFSTI: HC $3.00/MF $0.65

Two mathematical simplifications are presented to alleviate deficiencies of the analyses of the transport and deposition of fission products in a reactor coolant circuit. NSA

N68-10436# Oak Ridge National Lab., Tenn.

IN- AND EX-REACTOR STRESS-RUPTURE PROPERTIES OF HASTELLOY N TUBING

H. E. McCoy, Jr. and J. R. Weir, Jr. Sep. 1967 27 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1906) CFSTI: HC $3.00/MF $0.65

The stress-rupture properties of two heats of Hastelloy N tubing have been determined at 760°C in- and ex-reactor. Irradiation reduced the rupture life and the rupture strain, but no effects on the creep rate were detectable. Small variations in behavior of tubular specimens tested during irradiation and small rod specimens tested after irradiation are explained on the basis of differences in stress states and sizes of test sections. The effects of irradiation are rationalized on the basis of the behavior of helium which occurs in the metal as a result of the thermal $^{10}B(n,\alpha)$ transformation. Author (NSA)

N68-10440# Argonne National Lab., Ill.

REACTOR-ENGINEERING-DIVISION ANNUAL REPORT, JULY 1, 1965–JUNE 30, 1966

Apr. 1967 234 p refs

(Contract W-31-109-ENG-38)

(ANL-7290) CFSTI: HC $3.00/MF $0.65

The Argonne National Laboratory Reactor Engineering Division annual report contains the following sections: Experimental Breeder Reactor-II, the Argonne Advanced Research Reactor, the Experimental Boiling Water Reactor, the Argonne Nuclear Rocket Program, Fast Reactor Research and Development, Liquid Metal Heat Transfer Research Program, Magnetohydrodynamics, Reactor Safety Research and Development, and a Feasibility Study of a Nuclear Steam Supply System using a 10,000 MW Sodium-Cooled Fast Breeder Reactor. Separate abstracts have been prepared for each section. NSA

N68-10444# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.

ANALYSIS OF THE SEFOR MOCKUP CRITICAL EXPERIMENTS IN ZPR-3

A. B. Reynolds and S. L. Stewart Mar. 1967 54 p refs Prepared for Southwest Atomic Energy Associates

(Contract AT(04-3)-540)

(GEAP-5294; Rept.-4981-APO-61; Rept.-150-AT-3/67) CFSTI: HC $3.00/MF $0.65

A series of critical experiments were performed on a mockup of SEFOR at ZPR-3. Analyses of these experiments and the application of the results to the SEFOR design are discussed. Critical mass values were determined for 1-, 2-, and 3-segment SEFOR

fuel designs to help establish the Pu atom fraction in the SEFOR fuel. Reactivity effects of axial fuel expansion were measured which led to selection of the 2-segment design for SEFOR. Measurements of the reactivity worth of the radial reflector established the adequacy of the SEFOR reflector control system. The Doppler coefficient was measured. The calculated ^{238}U Doppler coefficient was in agreement with the experiment; the measured ^{239}Pu contribution to the SEFOR Doppler coefficient was near zero. It was demonstrated that the SEFOR Doppler is significantly more negative than the conservative value assumed for safeguards analysis. The maximum positive reactivity caused by loss of sodium was measured; the measured reactivity was small (+6 cents) and close to the calculated value. The ratio of prompt neutron lifetime to delayed neutron fraction was measured both by the pulsed neutron technique and by noise analysis. The values measured by the two techniques were in agreement. Fission ratios, fission and boron traverses, and Pu worth distributions were measured and are compared with calculations. Author (NSA)

N68-10446 AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).

ABSORBER EFFICIENCY IN LIGHT WATER MODERATED REACTORS [ABSORBERWIRKSAMKEIT IN LEICHTWASSERMODERIERTEN REAKTOREN]

J. Schulze Brussels, EURATOM Sep. 1967 70 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-082-66-1 TEED)
(EUR-3615.d, V. 1)

This report gives the results of measurements which have been conducted at the critical facility ALIZE in Saclay and at the AEG test reactor PR 10 in Grosswelzheim for determination of the influence of absorbing plates on the nuclear characteristics of a core. For several core arrangements, with and without absorber plates, the results of the following measurements at ALIZE are reported: temperature coefficient, critical mass, three-dimensional thermal and epithermal flux distribution. The experiments at the PR 10-reactor consisted of thermal and epithermal flux measurements perpendicular to the plate for two core arrangements and several different absorbing plates. The reactivity values of the different absorber elements have been determined for both cores utilizing pulsed neutron techniques. Author

N68-10447# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.

NIMROD OPERATION AND DEVELOPMENT Quarterly Report, Jan. 1–Mar. 31, 1967

D. E. Gray, ed. Jun. 1967 13 p refs
(RHEL/R-148) CFSTI: HC$3.00/MF$0.65

Operation of the accelerator and the experimental work in progress are described. The performance of the plunging mechanisms associated with the extraction system was improved significantly. The 80 cm liquid helium bubble chamber was commissioned, and re-installation of the 1.5m British National Hydrogen Bubble Chamber was completed. Installation of the X1/X2 extracted proton beam line is in progress. Author (NSA)

N68-10449# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.

GAS TRANSPORT IN MSRE MODERATOR GRAPHITE I: REVIEW OF THEORY AND COUNTERDIFFUSION EXPERIMENTS

A. P. Malinauskas, J. L. Rutherford, and R. B. Evans, III Sep. 1967 39 p refs
(Contract W-7405-ENG-26)
(ORNL-4148) CFSTI: HC$3.00/MF$0.65

Equations describing gas transport in porous media are derived. Many simplifying assumptions are made in deriving the formulas. Development of the theory proceeds logically from gas transport of a pure gas in a single capillary, to transport of a binary gas mixture in a single capillary, to gas flow through a bundle of capillaries, and finally, to gas flow through a porous medium. Equations are given for each type of transport. Practical applications of the theoretical concepts are also shown for a moderator graphite of the type used in the Molten-Salt Reactor Experiment (MSRE). The experimental findings are limited but significant. Under MSRE conditions it appears quite justifiable to ignore normal diffusion effects in gas transport computations. This means that all the gaseous diffusion information necessary to correlate fission product migration data may be gained through simple permeability measurements; the more complex interdiffusion experiments are not required. Thus a complete flow-property survey of all MSRE moderator materials can be performed with a minimum expenditure of time and effort. Author (NSA)

N68-10452 Ente Nazionale per l'Energie Elettrica (ENEL) Latina (Italy).

GARIGLIANO NUCLEAR POWER PLANT [CENTRALE ELETTRONUCLEARE DEL GARIGLIANO] Annual Report, 1966

Brussels, EURATOM Jun. 1967 104 p In ITALIAN; ENGLISH summary
(Contract EURATOM-003-61-12 REPI)
(EUR-3489.i) CFSTI: HC$3.00/MF$0.65

This report covers the period from May 1, 1966 to February 28, 1967. In said period the plant operated with an availability factor of about 89% and generated a total of approximately 1000 million kWhrs. The average fuel burnup since the plant was placed on line reached 7730 MWd/t of uranium, corresponding to a consumption of about 235 kg of U-235 and a production of about 184 kg of plutonium. A number of tests were performed to assess the stability of the reactor under higher power density and void content conditions. These tests demonstrated the good stability of the reactor under very severe operating conditions. Various control rod patterns and withdrawal sequences were considered in order to determine those giving highest uniformity in fuel consumption. The core pressure drop gradually increased, but was always well within the operation safety limits. In this reporting period, the Δp rose from 1.61 tot 5.66 psi at a daily rate of 0.016 psi. The suspended material in the primary circuit water (with iron prevailing over cooper and nickel) remained at relatively low values. Instead, an increased copper content, contributed more or less in the same measure by the high-temperature and low-temperature heaters, was found in the dissolved corrosion products. The amount of corrosion products in solution was also rather low. Author

N68-10453 AEG-Kernenergieanlage, Frankfurt am Main (West Germany).

ABSORBER EFFICIENCY IN LIGHT WATER MODERATED REACTORS [ABSORBERWIRKSAMKEIT IN LEICHTWASSERMODERIERTEN REAKTOREN]

K. Baur Brussels, EURATOM Sep. 1967 28 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-082-66-1 TEED)
(EUR-3615.d, V. 2)

The results of experiments, which had previously been carried out at the critical facility ALIZE in Saclay, AEG standard calculations. The calculated quantities were: multiplication factors, coefficients of reactivity for boron concentration, and temperature, and distributions of neutron flux. For cores without absorber plates the measured and calculated effective multiplication factors agree within 0.006 Δk_{eff}. In the initial calculations for cores with absorber plates the calculated reactivity equivalents of the absorber plates turned out to be too high. When an epithermal logarithmic surface

condition $\bar{\alpha}_2$=0.05 was used, instead of the initially calculated value $\bar{\alpha}_2$=0.1046, agreement between measurement and calculation was achieved. When a more realistic energy spectrum of neutron flux at the surface of the absorber plate was used for calculating the average quantity $\bar{\alpha}_2$, the result was $\bar{\alpha}_2$=0.055. The deviations of the calculated coefficients for boron concentration ranged from $+1.10^{-5}$ to 5.10^{-5} 1/mgB. The deviations of the calculated temperature coefficients ranged from -3.10^{-5} to -4.10^{-5} $(°C)^{-1}$. Author

N68-10454# Atomic Energy Commission Research Establishment, Riso (Denmark).
QUARTERLY REPORT OF THE ELECTRONICS DEPARTMENT FOR THE PERIOD OCTOBER 1–DECEMBER 31, 1966 [BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1 OKTOBER TIL 31 DECEMBER 1966]
Mar. 1967 32 p refs In DANISH
(RISO-M-534)

A progress report is presented on instrumentation. Topics discussed are design of a magnetic drum system for the PDP-8 computer, fuel leakage detection in water reactors, shutdown reactivity measurements, use of computer technique in safety, alarm, and interlock systems, quantitative determination of uranium and thorium using α spectrometry, and automatic curve adjustment in computer. NSA

N68-10460# Oak Ridge National Lab., Tenn.
CONSEQUENCES OF INTERNAL HEAT FLOW IN RADIOISOTOPE HEAT SOURCES
J. C. Posey [1967] 7 p refs Presented at the 2d Intern. Symp. on Nucleonics in Aerospace, Columbus, Ohio
(Contract W-7405-ENG-26)
(ORNL-P-3189; CONF-670714-5) CFSTI: HC $3.00/MF $0.65

Equations relating the maximum internal temperatures of various-shaped fuel forms and other source parameters are given. By using calculated results, the use of cermets is compared with the use of oxide-metal laminar structures as methods of decreasing the resistance to heat flow in the interior of heat sources and achieving higher surface heat fluxes without exceeding maximum allowable internal temperatures. The laminar composite fuel form is moderately superior. The expected vapor phase migration and equilibrium distribution of a volatile radioactive fuel inside a heat source capsule is described. Redistribution does not always result in serious problems and can reduce the cost of source fabrication. Author (NSA)

N68-10462# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorbauelemente.
THE DEVELOPMENT OF STEAM BLOWERS FOR STEAM-COOLED REACTORS [DIE ENTWICKLUNG VON DAMPFGEBLAESEN FUER DAMPFGEKUEHLTE REAKTOREN]
F. Erbacher and F. Radtke Feb. 1967 76 p refs In GERMAN
(KFK-545)

The Institute for Reactor Development has been working on the development of steam-cooled reactors since 1961. The characteristics of the steam circuit for such a reactor and the factors governing the selection of the steam state are outlined. The components of the coolant circuit are given and special design considerations for the development of steam blowers are discussed. The operational behavior of the prototype steam blower developed is reported. Design points for the further development are considered. The blower characteristics necessary for high reactor power are given. NSA

N68-10469# General Dynamics Corp., San Diego, Calif. General Atomic Div.
DIFFERENTIAL NEUTRON THERMALIZATION Quarterly Technical Report, 1 Jan.–31 Mar. 1967
W. L. Whittemore 28 Apr. 1967 35 p refs
(Contract AT(04-3)-167)
(GA-7959) CFSTI: HC $3.00/MF $0.65

Results of research on neutron scattering by liquid D_2O and reactor-grade graphite are reported. The analysis of results and comparisons made using the computer code GASKET are included. The results indicate justification of the aggregate model for liquid D_2O used in calculations by McMurry (Idaho Nuclear Corporation document No. IN-1020, Aug. 1966). Results on the upper cutoff in the frequency distribution for graphite were computed from GASKET and were found to compare favorably with measured results. NSA

N68-10470# General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Quarterly Progress Report
H. H. Klepfer, H. J. Bushboom, E. A. Pickett, D. M. Rooney, and R. E. Blood Jul. 1967 14 p refs
(Contract AT(04-3)-189)
(GEAP-5516; EURAEC-1901; QPR-17) CFSTI: HC $3.00/MF $0.65

A Zr+2.0 at % Cr+0.16 at % Fe alloy (Zr–Cr) were evaluated as nuclear fuel cladding. Alloy-clad fuel rods were irradiated in the Consumers Big Rock Point Reactor. The fuel irradiation was delayed by a variable corrosion performance of the first full-scale vendor batch of alloy tubing and bar stock. The difference between the variable performance by material from the large vendor ingot and the reproducibly excellent performance in the same tests by material from small laboratory melts was caused by nonuniform distribution of coarse intermetallic compounds in the vendor material. Laboratory studies have resulted in a proposed process for ensuring fine uniform intermetallics under vendor conditions. Both fuel rods and dummy rod containing precut corrosion and tensile samples were fabricated and shipped to Consumers. These rods were loaded into a reload fuel bundle designated B1 and loaded into the core during the May–June shutdown. Total exposure to date is ≈300 MWd/T U average. Characterization of vendor tubing and rod continued to show that the potential of the Zr–Cr alloy was realized on the second round of vendor materials. A brief description of fabrication history for the second round of vendor material is presented. Author (NSA)

N68-10475# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
EXPERIMENTAL SCATTERING LAW FOR VARIOUS REACTOR MATERIALS
I. M. Thorson Jun. 1967 22 p refs Presented at the IAEA Symp. on Neutron Thermalization and Reactor Spectra, Ann Arbor, Mich., 17–21 Jul. 1967
(AECL-2915; CONF-670707-14) CFSTI: HC $3.00/MF $0.65

The double differential neutron scattering cross sections for zirconium hydride and uranium dioxide were measured on the Chalk River phased-rotor spectrometer at the NRU reactor. The results are presented in the scattering law, $S(\alpha,\beta)$ form. The UO_2 data were taken for four specimen temperatures; results at 27°C and 500°C cover an energy transfer range 0.005 to 0.09 eV and at 1310°C and 1480°C, a range of 0.01 to 0.18 eV. The ZrH_x data were taken with a specimen temperature of 27°C for x=0, 0.63, 0.98 and 1.98; in all cases the cross-sections due to acoustical modes are negligible for energy transfers above 0.04 eV and the shape, if any, of the optical peak at 0.14 eV is not

resolved because of intensity and resolution limitations. The accuracy with which the absolute normalization and important corrections for background, detector sensitivity and multiple scattering can be made is discussed. Multiple scattering is shown to be a significant effect for the low momentum transfer measurements because it modifies the observed α dependence and the extrapolated S/α value at $\alpha=0$. Author (NSA)

N68-10483 European Atomic Energy Community, Brussels (Belgium).
STEELS WITH REDUCED SENSITIVITY TO NEUTRON-EMBRITTLEMENT: A SAFETY FACTOR
J. Sebille Sep. 1967 42 p refs Presented at the Panel of Experts on Recurring Inspection of Nucl. Reactor Pressure Vessels, Pilsen, Czechoslovakia, 3–7 Oct. 1966
(EURAEC-1883; EUR-3379.e)

After having stressed the importance of developing steels with reduced sensitivity to neutron embrittlement for fabricating nuclear pressure vessels, the author makes a review of the metallurgical parameters affecting radiation damage: ferritic grain-size, microstructure, composition, fabrication methods and melting practice, previous temper embrittlement, strain-ageing, etc. Conclusions are drawn as to the relative importance of these parameters. The phenomenon of recovery of impact properties through annealing (defect annealing) is also considered. Possible ways of reducing radiation damage by altering metallurgical variables are analyzed on the basis of experimental results and theoretical reasons. In the conclusions the nature of additional research needed to solve the problem is indicated. Author

N68-10532# Atomic Energy Establishment, Winfrith (England). Reactor Group.
THE ROLE OF DIGITAL COMPUTERS IN THE PHYSICS ASPECTS OF THE DESIGN OF GAS-COOLED GRAPHITE-MODERATED REACTORS
J. G. Tyror May 1967 14 p refs Presented at the Intern. Conf. on Res. Reactor Util. and Reactor Math. and Computation, Mexico City, 2–4 May 1967
(AEEW-M-754; CONF-670501-13) CFSTI: HC$3.00/MF$0.65

The developing use of digital computers in evaluating the physics aspects of graphite-moderated reactor design is discussed. Three broad categories of physics computation are the detailed and sophisticated computation which provides absolute results to check the validity of more approximate but quicker methods, the highly idealised calculation in which simplification has been sought since the physics calculation is but one part of some overall design computation, and core performance evaluations in which adequate accuracy is sought but with methods which are rapid and therefore allow many design variations to be studied. Physics computations for AGR, in particular fuel management calculations, are described. NSA

N68-10561* Georgia Inst. of Tech., Atlanta.
INVESTIGATION OF RADIANT HEAT TRANSFER TO PARTICLE-SEEDED GASES FOR APPLICATION TO NUCLEAR ROCKET ENGINE DESIGN
Edward Y. H. Keng and Clyde Orr, Jr. Washington NASA Nov. 1967 50 p refs
(Grant NsG-273)
(NASA-CR-953) CFSTI: HC$3.00/MF$0.65 CSCL 21F

The objective of this research is to provide fundamental information on radiant heat transfer to aerosols to aid in the evaluation of various gaseous core nuclear rocket concepts. Both theoretical and experimental investigations have been pursued. View factors have been evaluated for a number of conditions considering a cylindrical geometry for the system, such results being generally applicable to high temperature technology. The experimental results agree well with theoretical predictions. A new aerosol generator has been designed to produce dense yet uniform aerosols, and preparation for the study of particle evaporation or sublimation in an intense radiant field are underway. An electrically heated tungsten furnace for this investigation is being assembled. Author

N68-10629# Atomic Energy Board, Pretoria (South Africa).
VLOED: A FORTRAN IV DATA REDUCTION AND FLUX CALCULATION PROGRAM WRITTEN FOR USE ON THE IBM-360 DIGITAL COMPUTER
J. D. Visser and R. van der Walt May 1967 15 p refs
(PEL-148)

The program described was developed with the purpose of deriving neutron flux and spectrum parameters from foil data obtained after irradiation in the SAFARI I reactor and the Pelindaba critical facility. It was written for use on a 128K model 40G IBM-360 digital computer. The program requires 41423 bytes on the DOS-11 release 7 of IBM system 360, with a supervisor occupying 8191 bytes—thus using approximately 32% of the core space. Author (NSA)

N68-10688# TRW Systems Group, Redondo Beach, Calif. Physical Electronics Lab.
KINETIC STUDIES OF HETEROGENEOUS WATER REACTIONS Annual Summary Report, 1966
A. F. Firstenberg, G. H. Humberstone, L. G. Neal, L. B. Wentz, and S. M. Zivi Dec. 1966 129 p refs
(Contract AT(04-3)-372)
(STL-372-50) CFSTI: HC$3.00/MF$0.65

Accident conditions, pressure generation, fuel elements and melting effects, in-core pressure and capsule measurements, and transfer function measurements during subcooled boiling are discussed for water-cooled reactors. Attention is given to reactor safety and their effects, reactor fuels and uranium oxides, and use of metals. Heat transfer calculations for urania in water-moderated reactors are presented, and two-phase fluid flow effects on stability of power reactors are discussed. Other kinetic studies deal with a hydrodynamic analysis of an experimental boiling water reactor, and feedback effects on reactor stability. M.W.R.

N68-10694 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
REACTIVITY MEASUREMENTS IN THE R.O.S.P.O. REACTOR BY PULSED AND STATISTICAL TECHNIQUES [MISURE DI REATTIVITA SUL R.O.S.P.O. CON TECNICHE PULSATE E STATISTICHE]
N. Pacilio and T. Ferrari 1967 70 p refs In ITALIAN; ENGLISH summary
(RT/FI(67)22)

The reactivity coefficients of control rods, moderator level, and core temperature, and the measuring apparatus are described, and the different techniques of pulsed neutron source, neutron statistics, inverse multiplication, and stable period are compared. The mutual consistency among the results is extensively discussed. Author

N68-10709# Oak Ridge National Lab., Tenn.
IN-PILE HEAT TRANSFER STUDIES OF ROUGHENED HELIUM-COOLED REACTOR FUEL ELEMENTS

C. A. Brandon and G. J. Kidd, Jr. [1967] 6 p refs Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago, 5–9 Nov. 1967
(Contract W-7405-ENG-26)
(ORNL-P-3202; CONF-671102-2) CFSTI: HC $3.00/MF $0.65

Four reactor fuel elements were tested in LOOP No. 1 of the Oak Ridge Research Reactor for in-pile heat transfer data. Three of the elements were roughened surface and one smooth surface. The study shows that an increase in heat transfer can be obtained by the use of the types of surface roughness tested. NSA

N68-10724# Bettis Atomic Power Lab., Pittsburgh, Pa.
IRRADIATION BEHAVIOR OF ZIRCALOY-CLAD FUEL RODS CONTAINING DISHED-END UO_2 PELLETS (LWB-LSBR DEVELOPMENT PROGRAM)
R. M. Berman, H. B. Meieran, and P. W. Patterson Jul. 1967 118 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-629) CFSTI: HC $3.00/MF $0.65

Two fuel rods, BETT 79-21 and BETT 79-25, containing cylindrical UO_2 pellet with dished ends were irradiated in the B-4 Loop of the Materials Test Reactor to a depletion of 12.41 and 15.26×10^{20} fissions/cc, respectively. Rod 79-21 was irradiated for nine days in the failed condition prior to removal; it showed extensive circumferential ridging of the clad at the interfaces between pellets, as well as hydriding, cracking, and spalling of the clad. Rod 79-25 was removed before failure when it also showed circumferential ridigng of the clad. Approximately 35% of the total fuel swelling of a typical pellet was accommodated in the dishes; 49% more was accommodated in filling the internal porosity of the fuel material. The remaining 16% of the total swelling (combined with thermal expansion) is postulated to have caused the expansion of the diameter and ridging that led to failure. Total rate for all three types of fuel swelling was 0.82 v/o per 10^{20} fission/cc at the conditions under which these samples were irradiated. Author

N68-10725 Joint Publications Research Service, Washington, D. C.
NUCLEAR ENERGY INSTALLATIONS AND THEIR TECHNICAL POSSIBILITIES
A. I. Leypunskiy 7 Nov. 1967 12 p Transl. into ENGLISH from Kernenergie (Dresden), v. 10, no. 6, Jun. 1967 p 177–181 Presented at the Gen. Conf. of the Intern. Atomic Energy Organ., Vienna, 23 Sep. 1966
(JPRS-43265; TT-67-33889) CFSTI: $3.00

An overview is presented on the development, construction, and operation of various reactors, the prospects for constructing economical fast breeders and the problems involved, and nuclear energy programs in various countries. Among the findings reported are the following: (1) A considerable number of power plants under construction are nuclear power plants which operate with some fundamental type of thermal reactors. (2) Energy production based on nuclear energy has become an important industrial branch. (3) Operating experience with sodium-cooled fast reactors, and tests with fuel elements of uranium and plutonium dioxides indicate the feasibility of building a fast reactor which can supply cheaper electric energy than other types. M.G.J.

N68-10737 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EXECUTION PROCESS FOR THE THROUGH CHANNEL RELATIVE TO THE PROGRAM FOR POWER INCREASE OF THE 1 MW TRIGA REACTOR
G. Florita 1967 58 p
(RT/ING(67)10)

As part of a program to increase the power of the 1 MW Triga reactor, a tangential through channel was constructed to permit low gamma intensity experiments. Details of the topographical operations and the actual construction are described. R.N.A.

N68-10759# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ENGINEERING DEVELOPMENT DEPARTMENT Quarterly Report, July–September 1966
H. Harty, J. M. Batch, L. T. Pedersen, R. G. Wheeler, and J. C. Fox Aug. 1967 31 p refs
(Contract AT(45-1)-1830)
(BNWL-492) CFSTI: HC $3.00/MF $0.65

Heat transfer analyses for cermets and fuel elements used with a Fast Flux Test Reactor Facility are discussed. Gas cooling of the reactor, and temperature of the pin segmenting spacer for the reactor are described. Engineering and design of components and cores for the Phoenix Reactor and various other reactors is discussed. Work efforts connected with a plutonium utilization program; and experiments concerned with nuclear safety are reported. Metallurgical analyses of reactor pressure tubing consisting of zirconium and niobium base alloys were conducted. L.S.

N68-10766 Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorbauelemente.
HEAT TRANSFER AND PRESSURE DROP OF REACTOR FUEL ELEMENTS IN THE FORM OF LONGITUDINAL ROD BUNDLES [WAERMEUEBERGANG UND DRUCKVERLUST AN REAKTORBRENNELEMENTEN IN FORM LAENGS-DURCHSTROEMTER RUNDSTABBUENDEL]
Karlheinz Presser Jun. 1967 152 p refs In GERMAN
(JUL-486-RB) CFSTI: $3.00

Mean and local heat transfer measurements on gas-cooled fuel rod clusters for nuclear reactors are performed by analog evaluation between heat and mass transfer and isothermal pressure loss during startup to flow equilibrium. Approximately even flow distribution is reached at heat transfer $7 \times d_{hyd}$ for a cluster of seven fuel rods under simultaneous hydraulic and thermal startup. This value does not depend on Reynolds number and flow form. Rod clusters always show better heat flux transfer ability than tubular clusters. Transl. by G.G.

N68-10784 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
TEMPERATURE AND THERMAL STRESS DISTRIBUTION IN SMOOTH AND FINNED CANNINGS DUE TO AXIAL FLUX VARIATIONS
J. Reynen Brussels EURATOM Sep. 1967 44 p refs
(EUR-3557.e) CFSTI: $3.00

Temperature and thermal stress distributions due to thermal neutron flux peaking near the end plugs of fuel rods are determined for both smooth and finned cannings. The theory has been programmed on a digital computer. The code, named ATEAS, handles empirical flux distributions defined at a number of discrete points by assuming a linear flux distribution between adjacent points. Author

N68-10795# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.

NUCLEAR TECHNOLOGY BRANCHES Quarterly Report, Oct. 1–Dec. 31, 1966

May 1967 74 p refs

(Contract AT(10-1)-1230)

(IN-1083) CFSTI: HC $3.00/MF $0.65

Progress is reported on several phases of nuclear technology. Self-shielding effects of B_4C particles of various sizes have been studied. A comparison of values obtained by (a) reactivity measurements in the ARMF and (b) first-flight transport calculations indicates that results obtained by the two methods agree well for particle sizes smaller than 85 microns. The self-shielding factor, f_p for −325 mesh-size particles now being used in ETR and ATR fuel elements is 0.94. Insufficient fuel-plate to side-plate engagement was apparently the cause of premature failure of two ATR dummy fuel assemblies during the hydraulic proof test; whereas, inadequate swaging technique resulted in the failure of one fueled ATR fuel assembly during a similar test. Four other ATR dummy assemblies successfully withstood the hydraulic proof test although one was marginal in its performance. The fuel core width tolerances for the ATR fuel plates have been relaxed as a result of further investigations. A review of the allowable dogboning in MTR fuel assemblies has been completed, and the results are reported. Improvements in the response time of commerically available, sheathed, Type K thermocouples have been obtained by remaking the hot junctions using Cu and Ag rather than stainless steel. Post-operation measurements of the channel thicknesses of ETR fuel elements were made and are reported. Significant changes in these dimensions were observed. The results are given of an irradiation test program conducted for the Argonne Advanced Research Reactor. In this test, stainless steel clad plates fueled with UO_2 were irradiated in the G-12 pressurized water loop of the ETR at heat fluxes of 0.6 to 1.1×10^6 Btu/hr-ft^2 to exposures of up to 14.6×10^{20} fissions/cc. Post-irradiation examinations indicated that the samples were sound, that the fuel core swelling rates were lower than predicted, and that the failures produced by post-irradiation annealing were in good agreement with failure-no-failure data produced during irradiating testing by others on similar samples. Compatibility studies were made on tantalum, graphite, and Al_2O_3 with intermetallic fuel (UAl_x, U_3Si, or UCu_5) systems for the purpose of selecting a suitable heat transfer medium. Graphite appears to be most suitable. Author (NSA)

N68-10806 Argonne National Lab., Ill.

NUCLEAR FUEL MATERIALS

D. W. Readey and J. H. Handwerk *In* Natl. Bur. of Standards Nucl. Sci. and Technol. for Ceramists 26 May 1967 p 45–60 refs (See N68-10801 01-18)

Selection of a nuclear fuel material is dependent upon many compromises of material properties consistent with demands of the power generating system. Those properties which dictate the use of a given material for specific systems such as thermal and fast reactors, nuclear rocket engines, and direct conversion devices, are reviewed. Materials of interest are uranium, plutonium and thorium and their compounds either alone or combined with each other or with non-fissile materials. Technology at the present time is directed toward the utilization of primarily the oxides and carbides of fissile metals. However, their nitrides, sulfides, and phosphides show promise as potential fuel materials but the properties of these compounds must be more fully delineated before they can be considered for fuel purposes. Author

N68-10807 Battelle-Northwest, Richland, Wash.

REACTOR MATERIALS DESIGN

D. R. de Halas, W. C. Morgan, and M. D. Freshley *In* Natl. Bur. of Standards Nucl. Sci. and Technol. for Ceramists 26 May 1967 p 61–71 refs (See N68-10801 01-18)

Design problems in the use of graphite as structural and moderator materials in a nuclear reactor are discussed. The type of graphite to be used is controlled by the service temperature and type of atmosphere. Dimensional stability under irradiation is controlled by graphite structure. Effects of radiation damage, service temperature and atmosphere on the use of beryllium oxide are outlined. A summary of the several types of irradiation damage to nuclear control materials are given. Engineering aspects of ceramic fuel element design are used as a basis for discussion of materials coupling problems in reactor design. Stresses introduced by changes in the core often cause clad failure. Compatibility between the core and clad material, and effects of impurities in the core as acting on the clad, are also important. Service conditions affect the choice of materials, due to effects on performance of failed fuel elements, corrosion, and fission gas release. Author

N68-10851 Joint Publications Research Service, Washington, D. C.

THE USE OF SGD-8 GLASS FOR GAMMA-RAY DOSIMETRY IN THE IGR PULSED REACTOR

S. A. Sharoyko 24 Nov. 1967 4 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 21, no. 3, Sep. 1966 p 218–219

(JPRS-43438) CFSTI: $3.00

The calibration of the glass using a cobalt 60 source is briefly described. The dose rate was measured with a ferrosulfate dosimeter, and the determination of the trivalent iron ion concentration is outlined. The calibration curve of the dosimeter and the regression curve for the two holding temperatures are included. It was concluded that the SGD-8 glass affords stability of readings with repeated use, and it is suggested that this method of measuring gamma radiation doses is widely adaptable. N.E.N.

N68-10862# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

SENA SAFETY EVALUATION. FACTORS INVOLVED IN THE EVALUATION OF THE MAXIMUM CREDIBLE BORON RELEASE FROM THE CORE SURFACES OF A PWR WITH CHEMICAL SHIM

G. Petrangeli Brussels EURATOM Oct. 1967 14 p refs

(Contract EURATOM-009-65-10 REPC)

(EUR-3609.e)

The purpose of the present report is to offer a basis for the evaluation of an upper limit of reactivity input for the commonly named "boron-hideout accident". This accident would be caused by the sudden removal from core surfaces of previously deposited boron. The following items are briefly treated: phenomena leading to boron deposition on core surfaces; evaluation of the amount of crud deposited on core surfaces; evaluation of the amount of boron absorbed by crud; boron deposition due to the presence of alkali metaborates; boron depositions due to boric acid concentration on heat transfer surfaces; percentage of deposited crud which can be released during thermal transients; evaluation of reactivity release in a "boron-hideout accident". Experimental data on the phenomena possibly leading to boron deposition and release from core surfaces have been collected from the open literature, critically evaluated and presented in this report. A method is also described for the evaluation of an upper limit of the accidental reactivity insertion. The results of the application of this method to practical cases concerning pressurized water reactors of current design indicate that an upper limit for the reactivity insertion is of the order of a few tenths of a percent in $\Delta k/k$. Author

N68-10869 Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung.

HIGH TEMPERATURE VOLATILIZATION OF NEODYMIUM FROM THORIUM CARBIDE PARTICLES

L. A. Podo and H. Nickel Sep. 1967 26 p refs
(JUL-502-RG-RW) CFSTI: $3.00

Substantial decontamination of thorium carbide from isotopes of neodymium has been obtained by heating under vacuum at temperatures in the range 2000°–2800°C. Sol–gel processes have been adopted to prepare thorium carbide spherical particles containing 200 or 1000 ppm of neodymium. Nd^{147}($t_{1/2}$=11.1 d, γ=0.53 MeV) was used as a tracer for radiometric determinations. Author

N68-10871 Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL METHODS AND CONDITIONS FOR IRRADIATION OF MATERIALS
S. T. Konobeyevskiy 6 Nov. 1967 60 p refs Transl. into ENGLISH from the book "Deystliye Oblucheniya na Materialy" Moscow, Atomizdat, 1967 p 44–86
(JPRS-43250; TT-67-33874) CFSTI: $3.00

Theoretical and experimental considerations of several methods of irradiating materials are discussed. Irradiation with neutrons, with both elastic and inelastic collisions are described. Elastic collisions of electrons with atoms capable of causing atomic displacements and gamma ray–electron interactions are reviewed. Details are presented on bombarding with fission fragments, and on the resulting thermal and displacement peaks. Bombarding with accelerated ions is also considered, and a bibliography is included. N.E.N.

N68-10896# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
FEASIBILITY STUDY OF BOILING WATER REACTOR NUCLEAR STEAM SUPPLY SYSTEMS WITH CAPACITIES UP TO 10,000 MWT Final Report
R. W. Lockhart Feb. 1967 127 p
(Contract W-7405-ENG-26)
(GECR-5155) CFSTI: HC$3.00/MF$0.65

Design limitations were identified, and the development work required to alleviate these limitations is discussed. Conceptual designs for nuclear steam supply systems of nominal 5,000 and 10,000 MWt capacity are described. Emphasis was directed towards determining technical feasibility; although considered, economic optimization was not an overriding factor. It is concluded that boiling water reactor nuclear supply systems of thermal ratings of 5000 MW could be made available by 1970, and systems with single-unit thermal ratings up to 10,000 MW could feasibly be completed by 1975. The technologies and plant equipment items required for the latter systems are also described. E.C.

N68-10928# Tennessee Univ., Knoxville.
EXPERIMENTAL INVESTIGATION OF SPATIAL EFFECTS ON THE NEUTRON FLUCTUATION SPECTRA OF A LARGE NUCLEAR REACTOR
Anthony Ray Buhl (Ph.D. Thesis) Dec. 1967 141 p refs
(TID-23946) CFSTI: HC$3.00/MF$0.65

The experimental techniques used to determine the spatial dependence of neutron fluctuation spectra in large reactors is detailed. Cross-power spectral densities are measured by the use of a two-detector system. Instrumentation utilized is described in detail. The experiment configuration at the 305 Test Pile at Savannah River is described; experiment conditions are detailed. A tabular summary of data is presented. Data reduction is explained. Analysis of data recorded from each detector is presented graphically. Data are compared with theoretical predictions. Instrument details are presented; a computer printout of the program SEN (spatial effects on noise) is listed. 31 references. NSA

N68-10931*# United Aircraft Corp., East Hartford, Conn.
NUCLEAR CRITICALITY STUDIES OF SPECIFIC NUCLEAR LIGHT BULB AND OPEN-CYCLE GASEOUS NUCLEAR ROCKET ENGINES
T. S. Latham Sep. 1967 56 p refs
(Contract NASw-847)
(NASA-CR-90112; F-910375-2) CFSTI: $3.00 CSCL 21F

Analytical studies were conducted to determine the U-233 critical mass requirements for two specific vortex-stabilized gaseous nuclear rocket engines: a nuclear light bulb engine and an open-cycle engine. The specific open-cycle engine employs a single cylindrical cavity having both a length and a diameter of 6 ft. The specific nuclear light bulb engine employs seven separate cavities, each having a length of 6 ft; the total volume of all seven cavities approximately equals the volume of the single cavity of the open-cycle engine. The nuclear light bulb engine employs beryllium oxide between the unit cavities, layers of beryllium oxide and graphite surrounding the assembly of seven unit cavities, a relatively large amount of neutron-absorbing structural material in the end walls, seven separate exhaust nozzles, fuel and propellant injection ducts, and hot gases in the propellant and fuel regions. The open-cycle engine employs layers of beryllium oxide, graphite, and heavy water surrounding the cavity; various structural materials; an annular exhaust nozzle; fuel and propellant injection ducts; and hot gases in the propellant and fuel regions. Author

N68-10939 Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium).
THERMAL NEUTRON SPECTRA IN UNIFORM LATTICES. USE OF CADILHAC'S FORMALISM
P. Haubert Brussels, EURATOM Aug. 1967 62 p refs
(Contract EURATOM-001-64-1 TRUB)
(EUR-3350.e; EURAEC-1814)

The use of the synthetic model of thermalization for the evaluation of neutron spectra in homogeneous and heterogeneous systems and more specifically in the unit cell of a uniform lattice is discussed. In homogeneous systems the neutron flux and the slowing-down density obey two coupled differential equations describing the conservation and the thermalization of neutrons. The neutron flux can be evaluated in different ways, for example by transforming this set of equations into two first order differential equations, or into a Shrödinger equation or still into a Riccati equation followed by a straightforward integration. In heterogeneous systems such as the unit cell of a uniform lattice, the fine structure of the flux can very often be evaluated at each energy by monoenergetic transport or diffusion theory. For instance, the method of Amouyal and Benoist uses integral transport theory in the fuel region and adjusted diffusion theory in the moderator. This method can be generalized by the determination of the flux in the fuel element, cladding included, with the help of collision probabilities in annular systems; the use of diffusion theory in the moderator region can also be avoided. Once the fine structure has been determined, effective cross-sections can be defined and the treatment of thermalization in these systems can be done in exactly the same way as in homogeneous systems. Author

N68-10949# Kernforschungszentrum, Karlsruhe (West Germany).
PHASE RELATIONSHIPS, FABRICATION AND PROPERTIES OF SUB-STOICHIOMETRIC OXIDE NUCLEAR FUEL (UO_{2-x}/ AND $(UPu)O_{2-x}$)
F. Thuemmler, R. Theisen, and E. Patrassi Feb. 1967 34 p refs Transl. into ENGLISH from German Sponsored jointly by US-EURATOM
(EURFNR-286; KFK-543)

The concept of a sub-stoichiometric oxide nuclear fuel is discussed in the light of the publications and our own results. At

low temperatures there is no danger of a metallic U or Pu precipitation with the Pu contents. The problems posed by the fabrication of pellets and vibration powder from $(UPu)O_{2-x}$ are technically solvable. Compatibility with clad materials is improved in the case of one-phase sub-stoichiometric products. Heat conductivity is increased moderately, at least up to 1200 to 1500°C. The improved heat conductivity is also apparent in the practical irradiation test. Author (NSA)

N68-10951 Gemeenschappilijke Kernenergiecentrale Nederland, Dodewaard.

50 MWe DODEWAARD NUCLEAR POWER PLANT [KERNENERGIECENTRALE VAN 50 MWe TE DODEWAARD] Annual Report, 1966

Brussels EURATOM Nov. 1967 134 p In DUTCH; ENGLISH Summary
(Contract EURATOM-008-63-4 REPN)
(EUR-3617.n)

Owing to prolonged delays in the fabrication of the pressure suppression tanks and the reactor housing (pressure-suppression system) the original construction schedule had to be altered. The remaining buildings (notably the turbine hall and auxiliary buildings) were completed on time. Preparations are being made for the construction of the biological shield. The main reasons for the delay in the fabrication of the containment were difficulties in the hot-shaping of the vessel bottoms and in the welding processes. After the welding of the reactor pressure vessel and the provision of a stainless-steel lining, there were long delays due to faults in the welded areas of the nozzles. During the year supply contracts were also concluded for the control rods, the in drives and the neutron-flux measurement system. Fabrication has begun. The turbine bedplate was installed. Construction of the turbine is proceeding with some delay, but without serious difficulties. Construction of the generator and main transformer, and installation of the electrical equipment are proceeding according to plan and without complications. The preliminary work for the piping assemblies for the various auxiliary systems have been almost completed. Author

N68-10960 Japan Atomic Energy Research Inst., Tokyo. Div. of Power Reactor Development.

A PRELIMINARY STUDY OF REACTOR THERMAL CHARACTERISTICS (HEAVY WATER MODERATED CARBON DIOXIDE COOLED REACTOR)

Sadamu Sawai, Yoshihiro Tadokoro, and Toko Seya Sep. 1967 20 p refs
(JAERI-1145)

A preliminary study of the reactor thermal characteristics of the heavy water moderated carbon dioxide cooled reactor was made and the following conclusions or results were obtained: (a) over 60 kg/cm^2 of the coolant pressure will be considered for the plain surface of the fuel, (b) the coolant temperature rise through the core would be taken over about 250°C considering the blower power required, and (c) some study of the properly designed core shape from the standpoint of the thermal characteristics was made and the range of the thermal design parameters to be considered were obtained. Author

N68-10973# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

CONTEMPT, A COMPUTER PROGRAM FOR PREDICTING THE CONTAINMENT PRESSURE–TEMPERATURE RESPONSE TO A LOSS-OF-COOLANT ACCIDENT

L. C. Richardson, L. J. Finnegan, R. J. Wagner, and J. M. Waage Jun. 1967 81 p refs
(Contract AT(10-1)-205)
(IDO-17220) CFSTI: HC $3.00/MF $0.65

The CONTEMPT computer program predicts the pressure–temperature response of a dry well containment building to a loss-of-coolant accident. This report describes the analytical model developed for the containment response and also serves as the user's guide for the computer program. The model assumes that the loss-of-coolant accident can be separated into phases, such that the results of the analysis of one phase serves as the initial conditions or the time-dependent input to the next phase. Thus, the containment model is only concerned with the pressure and temperatures in the containment volume and the temperatures through the containment structure. The computer program input provides for the description of the discharge of coolant, the boiling of residual water by reactor decay heat, the superheating of steam passing through the core, and metal–water reactions. The containment volume is separated into a liquid region and vapor region. Each region is assumed to have a uniform temperature, but the temperatures of the two regions may be different. The containment building is represented as consisting of several heat-conducting structures whose thermal behavior can be described by the one-dimensional multi-region heat-conduction equation. The program also calculates building leakage and the effects of engineered safeguard devices. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-10037* Farnham (Frank C.) Co., Philadelphia, Pa.

CALCULATION OF THE ATTENUATION OF LOW-FREQUENCY SOUND WAVES IN STRAIGHT LINED DUCTS [RASCHET ZATUKHANIYA SVUKOVYKH VOLN NIZKIKH CHASTOT V PRYAMYKH OBLITSOVANNYKH KANALAKH]

G. D. Malyuzhinets and R. D. Filippova Washington NASA Nov. 1967 11 p refs Transl. into ENGLISH from Prom. Aerodinamika (USSR), v. 18, 1960 p 3–11
(Contract NASw-1497)
(NASA-TT-F-11334) CFSTI: $3.00 CSCL 20A

A formula for calculating the attenuation of low frequency sound waves in air ducts is derived and verified experimentally. Rectilinear propagation of sound is considered in a slot between two walls, one of which is completely rigid, and the other is lined with a sound absorbing material that has an absorption coefficient for normal sound incidence. The duct walls were fabricated from 10-mm thick plywood panels and faces. The experimental setup for duct testing included a loudspeaker inside a sound absorbing box, a piezoelectric microphone, and a damper composed of wedge shaped sound absorbers. A comparison of the experimental and calculated attenuation curves indicates that the theoretical formula, $\Delta L_1 = 20 \log e^{kl\sqrt{m}}/1 - iG/ka$, is quite suitable for calculating attenuation in straight lined ducts under conditions of the propagation of low frequency sound waves. Author

N68-10061* Lockheed Missiles and Space Co., Huntsville, Ala.

SOURCE CHARACTERISTICS PROGRAM FROM A STATISTICAL ANALYSIS OF ACOUSTIC MIDFIELD DATA

Juergen Haukohl Oct. 1967 76 p refs Prepared in cooperation with Northrop Space Labs.
(Contract NAS8-20082)
(NASA-CR-61182) CSCL 20A

A digital computer program is described that is designed to reduce midfield acoustic data from many captive firings of full-scale rocket engines into a statistical analysis and acoustic source characteristics. The statistical analysis was performed using the sample mean squared pressures. The acoustic source characteristics are based on the ensemble average of mean squared acoustic pressures. They include such characteristics as directivity, total power and normalized power. The program uses parameters such as engine operational parameters, exhaust angle, distance to the microphones, octave center band frequencies and number of runs. The normalization of acoustic power output with these parameters allows comparison with different geometrical and engine configurations. The mean squared pressures are time averaged quantities. They are associated with the mean squared sound pressure at given spatial locations. Author

N68-10076# Columbia Univ., New York. Columbia Radiation Lab.
EFFECTIVE OPERATOR FORMALISM IN OPTICAL PUMPING
W. Happer and B. S. Mathur Jun. 1967 55 p refs Submitted for publication
(Contract DA-28-043-AMC-00099(E))
(AD-656474)

Real and virtual absorption of weak monochromatic light is analyzed with semiclassical radiation theory. The influence of the light on the atoms is described by an effective ground-state Hamiltonian operator and the effect of the atoms on the light is described by a dielectric susceptibility operator. These operators are expressed explicitly in terms of familiar ground-state observables, angular factors, oscillator strengths, and plasma dispersion functions. The theory gives a comprehensive description of optical pumping, light shifts, and light modulation due to real and virtual absorption of light, and several new effects are predicted. Repopulation of the atomic ground state from a polarized excited state is not considered in this paper. Author (TAB)

N68-10177*# Maryland Univ., College Park. Dept. of Chemical Engineering.
[CRITICAL EVALUATION AND COMPILATION OF VISCOSITY AND DIFFUSIVITY DATA] Semiannual Status Report, May 1–Oct. 31, 1967
31 Oct. 1967 8 p
(Grant NGR-21-003-053)
(NASA-CR-89955) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Diffusion coefficient measurements of seventy pairs of binary noble gas mixtures (monatomic–monatomic; monatomic–polyatomic; polyatomic–polyatomic systems) were correlated and evaluated. A data logging and retrieval system that will facilitate data storage and recall on a selective basis was devised. The data retieval program was written for the IBM 7090-94 digital computer system using Fortran IV. Work efforts concerning the evaluation of the diffusion coefficients for AgCl, and polymer diluent systems are also reported. A compilation of literature on turbulent transport coefficients was completed. L.S.

N68-10197*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UNIFORM LOCAL RESPONSIVITY OF DETECTORS BY SCANNING
Mitchell W. Finkel Nov. 1967 11 p refs
(NASA-TM-X-63020; X-713-67-537) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A method is outlined that effectively achieves uniform local responsivity without accepting the limitations inherent in such devices as diffusing screens and averaging spheres. The local responsivity of the detector and the intercepted radiant flux are considered as two random variables. Equations are developed for the radiant flux and the responsivity. An experiment is described to determine the response curve of the scanning process. It was concluded that the error from local nonuniform responsivity can be substantially reduced. N.E.N.

N68-10223* National Aeronautics and Space Administration, Washington, D. C.
COLLIMATION OF CONCAVE GRATINGS AT GLANCING INCIDENCE [ZUR JUSTIERUNG DES KONKAVGITTERS IN STREIFENDER INZIDENZ]
G. Rathenau and P. K. Peerlkamp Nov. 1967 17 p refs Transl. into ENGLISH from Physica (Utrecht), v. 2, 1935 p 125–143
(NASA-TT-F-11363) CFSTI: $3.00 CSCL 20F

The collimation of concave gratings at glancing incidence, by means of a simple and systematic method using only optical aids is described, with mathematical formulas for calculating the collimation error and typical examples for the collimation procedure. Visible light is used for collimating the instrument for the extreme ultraviolet. The described method, using a direct-vision prism and a polychromatic light source (carbon arc), is accurate even if the ends of the spectral lines are not sharply defined. Author

N68-10346* Ohio State Univ., Columbus. ElectroScience Lab.
A MORE EXACT THEORY OF BISTATIC SCATTERING FROM STATISTICALLY ROUGH SURFACES
Li-jen Du 6 Nov. 1967 34 p refs
(Grant NsG-213-61)
(NASA-CR-90091; TR-1388-25) CSCL 20H

The bistatic scattering from rough surfaces has been studied. The results provide an extension of the work done for improving the theory of backscattering from rough surfaces. The analysis starts from the Stratton–Chu vector integral equation for the field in space in terms of the field vectors on the scattering surface and the free space three dimensional Green's function. At each point on the scattering surface the incident field is resolved into parallel and perpendicular polarized components and physical optics principle is used to find the corresponding scattered field. The resultant integrals are evaluated under several assumptions. Closed form solutions for the bistatic scattering cross sections are obtained for two statistical models of rough surfaces. Author

N68-10354*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTICAL ALIGNMENT OF SILICON CRYSTALS
Felix E. Geiger and Sidney Brashears (Electro-Mech. Res., Inc.) Washington NASA Nov. 1967 11 p refs
(NASA-TN-D-4187) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The principles of optical alignment of crystals, specifically silicon, are discussed. A relatively simple apparatus is described which allows crystal orientation to within $\pm 2^{\circ}$ or better, depending on the crystal plane. Data are presented and optical reflection patterns are given which identify not only the usually given |100|, |110|, and |111| planes but also the |311| and |122| planes. The usefulness of the latter two is pointed out when crystal orientations in more than one direction are required. The relationship between reflectograms and stereographic projection of crystal planes, and the latter's use for identifying optical reflections, are pointed out. An Appendix gives some useful hints on cutting such crystal wafers as required in solar cell and transistor technology, and in the measurement of Hall effect, resistance, and electron spin resonance. Author

N68-10366 International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY OF THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, JULY–SEPTEMBER, 1967
J. J. Diamond, ed.—Natl. Bur. of Std. Sep. 1967 75 p refs *Its* V. 1967, No. 3
(Rept.-3)

An annotated bibliography is presented for published papers on: (1) devices for measuring and controlling temperatures above 1500°C, and for physical measurements at temperatures above 1000°C; (2) properties, at temperatures above 1000°C, of materials which melt above 1500°C; (3) phase equilibria; and (4) reactions at temperatures above 1000°C. A listing of ten published books which pertain to high temperature chemistry and physics is also given. E.C.

N68-10549# California Univ., Berkeley. Lawrence Radiation Lab.
SUPERCONDUCTING HOLLOW CYLINDER AS A MAGNETIC LENS
H. Boersch, O. Bostanjoglo, and K. Grohman Mar. 1967 4 p ref Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 20, 1966 p 193–194
(UCRL-TRANS-1348) CFSTI: HC $3.00/MF $0.65

The magnetic flux, trapped in a superconducting cylinder, was used for electron-optic imaging. The magnetic field of superconducting lenses can have smaller dimensions and a greater constancy than that of conventional magnetic lenses. Author (NSA)

N68-10559# Illinois Univ., Urbana. Antenna Lab.
IMAGING WITH COHERENT FIELDS
Raj Mittra, and Preston L. Ransom May 1967 66 p refs *Its* Antenna Lab. Rept.-67-3
(Contract AF 19(628)-3819)
(AFCRL-67-0401; TR-12; AD-659168)

A diffraction theory of imaging is presented which is free of any apriori constraint on the wavelength and as such serves as a basis for imaging not only at optics, but microwaves and acoustics as well. The paper presents analytical procedures for producing real and virtual images and relates them where possible to physical systems such as holography. The solution to the exterior reconstruction problem (and thus the virtual imaging problem) is obtained by an application of Huygens principle. So, when the recording surface completely encloses the object, an exact virtual image can be obtained analytically or experimentally for a recording surface of arbitrary shape. The interior reconstruction problem, better known in diffraction theory as the inverse scattering problem, is, in general, more difficult than the exterior problem. It is found that unlike the virtual imaging case, the procedure for reconstructing the real image is a function of the recording surface shape. Furthermore, by explicit consideration of the visible and invisible spectral components of the scattered fields, it is shown that there exist no physical system capable of producing an exact real image. Indeed conventional holography obtains the real image only when the recording is planar and then it only reconstructs essentially the visible spectral components of the real images - even if the recording surface is of infinite extent. Author (TAB)

N68-10639# California Inst. of Tech., Pasadena. Antenna Lab.
POTENTIAL OF A CHARGED CYLINDER
John Lam Aug. 1967 20 p refs
(Contract AF 49(638)-1266)
(AFOSR-67-1876; AD-659376)

A method, based on complex variable theory, is presented for solving potential problems involving conducting solids of revolution. Attention is paid exclusively to the right circular cylinder, both because this problem possesses a high degree of symmetry which brings about certain simplifications, and because comparison can be made with previous results. The generalization from the cylinder to other axially symmetric geometries should become obvious. This method depends on the establishment of an intergral representation for the potential function which leads to the formulation of the problem in terms of a pair of coupled Fredholm integral equations of the first kind. As an illustrative example, these equations are solved numerically in the lowest approximation and the capacitance of the cylinder is calculated. Author (TAB)

N68-10674* Mississippi State Univ., State College.
MICROWAVE SPECTROSCOPY OF MOLECULES: BIBLIOGRAPHY, 1964–1966
Gordon E. Jones, B. Wayne Castleman, and Rudolph G. Oswald Washington NASA Nov. 1967 42 p refs
(Grant NGR-25-001-008)
(NASA-CR-951) CFSTI: $3.00 CSCL 07D

A bibliography is presented on the various studies pertaining to the adaptation of microwave spectroscopy to the problem of detecting and identifying contaminants in the atmosphere of closed space capsules. Emphasis is placed on the microwave measurement of gases, and the listings are grouped according to inorganic molecules and organic molecules. M.G.J.

N68-10689# Sandia Corp., Albuquerque, N. Mex.
PRINCIPLES OF OPERATION OF THE INDIUM ADHESION TESTER USED FOR SURFACE CONTAMINATION MEASUREMENT
G. L. Krieger Aug. 1967 7 p refs Presented at the AEC/NSA Contamination Control Symp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-DC-67-2001; CONF-670919-1) CFSTI: HC $3.00/MF $0.65

The basis for the use of solid–solid adhesion as a measure of surface cleanliness is discussed. Equipment and procedures are described for practical use of the effect and typical test results given. Author (NSA)

N68-10705 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF OPTIMUM TRAJECTORIES
M. K. Takabaev [1967] 7 p refs Transl. into ENGLISH from the book "Differential Equations and Applications" Alma Ata, Nauka Press, 1967 p 88–94

The problem of programming the thrust and controlling a flying vehicle for optimum trajectories is considered. The vehicle, treated as a variable mass body, moves in a homogeneous gravity field and in a resistive medium under the effect of a thrust directed along the longitudinal body axis. R.N.A.

N68-10709# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.
EFFECT OF GROUP-CONSTANTS AVERAGING PROCEDURE ON FEW-GROUP REACTIVITY CALCULATIONS
Ehud Greenspan [1968] 6 p refs Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago, 5–9 Nov. 1967
(Contract AT(30-3)-328)
(RPI-328-99; CONF-671102-6) CFSTI: HC $3.00/MF $0.65

The extent to which different reactivity coefficients may be affected by the averaging procedure and intercompares between the conventional, the bilinear, and a consistent averaging procedures are investigated. NSA

N68-10710 Lockheed Missiles and Space Co., Palo Alto, Calif.
MEASUREMENT OF THE RAREFIED GAS DENSITY BY THE METHOD OF RECORDING THE GLOW CAUSED BY AN ELECTRON BEAM
L. N. Malakhov and G. A. Bogdanovskii 1967 4 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), no. 7, 1967 p 65–66

Methods for measuring gas density below 10^{-2} torr are described. For increased sensitivity, a circuit was constructed which permitted modulation of the light flux emitted by the gas. The radiation recorded by the photoelectronic adapter was modulated by deflecting the electron probe in a direction perpendicular to the optical axis of the adapter. The electron probe was deflected at a frequency of 820 Hz using an electromagnetic deflecting coil. Results indicate that a proportional dependence exists between the gas density and the photo-current intensity in the 5×10^{-2} torr range. The magnitude of the photo-current was also directly proportional to electron probe current. The minimum value of air density determined using the apparatus developed for the experiments was: $\rho_{min}=1.6\times10^{-8}$ mg/cm^3, corresponding to an air pressure at room temperature of $P_{min}=10^5$ torr. E.C.

N68-10738* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
FURTHER EXAMPLES OF "MACHIAN" EFFECTS OF ROTATING BODIES IN GENERAL RELATIVITY
Jeffrey M. Cohen and Dieter R. Brill Nov. 1967 18 p refs
(NASA-TM-X-60605) CFSTI: $3.00 CSCL 20J

The exact field equations for the metric of axially symmetric stationary rotating bodies in general relativity are exhibited. They are applied to calculate, to first order in the angular velocity of rotation (but without restriction to weak gravitational fields), the rotation of the inertial frame induced by an incompressible fluid sphere, and by concentric mass shells. In addition, the effect of the exterior field of rotating bodies on light rays is discussed. The results appear to agree qualitatively with some of Mach's ideas on the origin of inertia. Author

N68-10761# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
THEORY OF THE HOMOGENEOUS INCEPTION OF GAS PORES IN METALS [TEORIYA GOMOGENNOGO ZAROZHDENIYA GAZOVYKH POR V METALLAKH]
L. P. Semenov 1966 14 p refs In RUSSIAN
(FEI-44)

If a metal is subjected to cyclotron bombardment by inert gas ions, a strongly supersaturated solution of inert gas in metal is obtained. At a sufficiently high temperature the supersaturated solution breaks down to form a large number of gaseous pore-complexes consisting of gas atoms and vacancies. An analogous situation takes place in fissionable materials. This process can be considered as a specific phase transition. In this case the gaseous pores play the role of nuclei of the new phase. The homogeneous growth of the new phase was investigated mathematically on breakdown of a supersaturated, inert gas, solid solution. An expression was obtained for the critical pore size, and the rate of formation of stable nuclei was also found for the quasistationary period of the conversion. NSA

N68-10868# Naval Ship Research and Development Center, Annapolis, Md. Marine Engineering Lab.
EXPERIMENTAL SURVEY OF ABSORBENT ACOUSTICAL MATERIALS FOR LIQUID PIPING SYSTEMS
Lee F. Heiner Sep. 1967 42 p refs
(NSRDC-2450; AD-659292)

Various materials were tested as pipe-wall liners for reducing fluidborne noise in liquid piping systems. It was found that flexible, porous materials and material composites are effective in liquids. The effects of liquid column and mechanical resonances of a system on an acoustic filter can be somewhat alleviated through the addition of resonant absorbers to the material. Author (TAB)

N68-10913 Technische Hochschule Hannover (West Germany).
MEASUREMENT OF THE EFFECTIVE IONIZATION ENERGY IN GASES [MESSUNG DER EFFEKTIVEN IONISIERUNG-SENERGIE IN GASEN]
Klaus-Peter Schulze (Ph.D. Thesis) [1966] 43 p refs In GERMAN

Described is a measuring method to obtain the energy necessary in forming ion pairs through absorption of ionizing radiation in gases. Proportional counter and ionization chamber are combined to determine energy and charge values of electronegative gases with an accuracy of up to ±2%. Effective ionization energies are determined for air, carbon dioxide, argon, methan, and some gas mixtures. Transl. by G.G.

N68-10999 Belgian Royal Observatory, Uccle.
A DEFLECTOR [UN DEVIATEUR]
E. Vandekerkhove 1967 30 p refs In FRENCH Submitted for publication *Its* Commun. Ser. B, No. 16

A two-mirror assembly is conveniently placed in front of the guide for a telescope with a prism objective so that pictures of stellar objects will be taken on the center of a photographic plate. This assembly, a deflector to improve astronomical photography, is described in detail; including the various ways in which it can be used. Transl. by M.W.R.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-10007# Duke Univ., Durham, N. C.
[PARTICLE PHYSICS] Progress Report, 1 Oct. 1966–Jul. 1967
Earle C. Fowler 26 Jul. 1967 9 p refs
(Contract AT(40-1)-3065)
(ORO-3065-13) CFSTI: HC$3.00/MF$0.65

A summary of research on K^-+p interactions near 740 MeV/c in the hydrogen bubble chamber is presented. Included in the interactions studied are resonance production and η production and decay modes. Author (NSA)

N68-10012# California Univ., Riverside.
[PARTICLE PHYSICS] Annual Report
Peter E. Kaus and B. R. Desai May 1967 23 p
(Contract AT(11-1)-34)
(UCR-34P107-49) CFSTI: HC$3.00/MF$0.65

A summary of the research both completed and in progress at the University of California, Riverside, is presented. This research concerns the various theoretical properties of hadron interactions and decays, and use is made of Regge pole and S-matrix theory, and current algebra. J.F.P.

N68-10013# Brookhaven National Lab., Upton, N. Y.
SIGMA CENTER, NEUTRON CROSS SECTION COMPILATION CENTER SCISRS NEWSLETTER. PART A. REFERENCE AND BIBLIOGRAPHY
Jun. 1967 139 p refs
(BNL-50061A) CFSTI: HC $3.00/MF $0.65

A listing by reference of the literature incorporated into the SCISRS bibliographic system is presented together with a bibliographic index that is listed by accession number (reference abbreviation.) NSA

N68-10023*# IIT Research Inst., Chicago, Ill. Technology Center.
PREDICTION OF NEUTRON INDUCED ACTIVATION. VOLUME II: NAP, PHYSICAL MODELS AND EXPERIMENTAL VALIDATION Final Report, May 14, 1964–Jan. 31, 1966
David A. Klopp 31 Jan. 1966 177 p refs
(Contract NAS8-11160)
(NASA-CR-89958; IITRI-A6088-22, Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 20H

An IBM 7094 computer program was written for the prediction of neutron induced activation. This report describes the physical models which form the basis for the computer programming and the experimental validation of the computer program. The physical models discussed here include one-dimensional neutron transport, estimation of neutron activation cross sections, and time dependence of radioisotope atomic concentrations. The experimental validation compares computed results of the NAP code, including neutron flux distribution, cross section calculation, and neutron induced gamma ray source strengths, to experimental data obtained here and from other laboratories. Author

N68-10024# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
THE J_N METHOD FOR NEUTRON TRANSPORT PROBLEMS IN A HOMOGENEOUS SLAB
T. Asaoka Sep. 1967 50 p refs
(EUR-3620.e) CFSTI: HC $3.00/MF $0.65

The j_N method (a new analytical approach) is applied within the context of a multigroup model to solve neutron transport problems for an infinite homogeneous slab with finite thickness under the assumption that the scattering of neutrons is spherically symmetric in the laboratory system. Stationary energy-space-angle dependent problems are treated as a special case of time dependent problems. The numerical results for the vector flux generated by a stationary boundary source show that the j_5 approximation gives an accuracy comparable to the S_8 approximation in Carlson's theory, regardless of the size of the system. The numerical values of the time-eigenvalues are shown for a one-group model and those of the first eigenvalue (asymptotic decay constant) are compared with Judge and Daitch's results. Their values agree well with the results of our j_0 approximation but appear slightly too large for thick slabs when compared to the more accurate j_4 results. Author

N68-10038 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
LONGITUDINAL TOLERANCES IN THE ACCELERATING STRUCTURE OF THE 10 MEV SWIERK PROTON LINEAR ACCELERATOR [TOLERANCJE WZDLUZNE W STRUKTURZE PRZYSPIESZAJACEJ AKCELERATORA LINIOWEGO PROTONOW 10 MEV W SWIERKU]
J. Sura 1967 22 p refs
(INR-790/SLBAL/PL)

The tolerances of the accelerating field distribution and drift tube alignment are determined. The respective values are $\langle \delta E_0/E_0 \rangle = 1.7\%$ and $\langle \delta Z/\lambda\beta \rangle = 0.12\%$. The method of calculation of field correction is given. The effects of vibrations of accelerating structure elements are discussed. Author

N68-10039# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SEARCH FOR LEPTONIC QUARKS WITH MASSES BETWEEN 100 AND 900 MEV [SUCHE NACH LEPTONISCHEN QUARKS MIT MASSEN ZWISCHEN 100 UND 900 MEV]
G. Bathow, E. Freytag, H. D. Schulz, and K. Tesch Jun. 1967 21 p refs In GERMAN; ENGLISH summary
(DESY-67/20)

A search was performed for photoproduced leptonic particles with fractional charges (leptonic quarks). With a 99% statistical significance, none were found with charges 1/3 and 2/3 and masses below 850 and 900 MeV. Author (NSA)

N68-10058# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
INELASTIC NEUTRON SCATTERING AND LATTICE DYNAMICS OF METALS IN QUASI-ION APPROXIMATION
K. Krebs and K. Hoelzl Sep. 1967 27 p refs
(EUR-3621.e, Pt. 1) CFSTI: HC $3.00/MF $0.65

The inelastic neutron scattering method offers the best and most direct way to measure phonon dispersion curves. A model is presented here that describes the experimentally observed dispersion curves for metals as arising from a screened interaction between quasi-ions. The form factor of the quasi-ions i.e., their effective potentials—obtainable by nonlinear least square fitting to neutron data or approximatively to elastic constants—are basic quantities for the calculation of thermodynamic and electronic properties of real metals. The present report develops and collects the pertinent formulae for the model and some of its representative applications. Author

N68-10062# Brookhaven National Lab., Upton, N. Y.
MEASUREMENT OF THE SHIFT IN FREQUENCY OF THE COHERENT VERTICAL BETATRON OSCILLATIONS AT INJECTION AS A FUNCTION OF BEAM CURRENT IN THE AGS
E. C. Raka 18 Jul. 1967 5 p refs
(BNL-11631) CFSTI: HC $3.00/MF $0.65

When a circulating synchrotron beam executes coherent betatron oscillations, image forces arising from fields induced by the beam in the vacuum chamber and magnet poles can alter the oscillation frequency. This frequency shift is usually negative and for small $\Delta\nu$ and large ν it is directly proportional to the number of particles present. A method for determining $\Delta\nu$ is outlined. NSA

N68-10094# Royal Inst. of Tech., Stockholm (Sweden). Electron Physics Div.
TWO-FREQUENCY MICROTRON
S. Rosander 1 Aug. 1967 1 Aug. 1967 Submitted for publication
(Rept.-67-15) CFSTI: HC $3.00/MF $0.65

A method of increasing the beam current of a microtron is described. With the aid of a second resonator, large phase-stable regions can be obtained. Author (ESRO)

N68-10129 Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
SELFCONSISTENT TREATMENT OF COLLECTIVE VIBRATIONS IN TERMS OF BOSON EXPANSIONS
Bent Sorensen Sep. 1967 38 p refs
(RIFP-65)

Earlier, a rapidly converging boson series expansion of fermion pair operators was suggested, and application to collective vibrations was discussed. This theory is now extended by introducing a selfconsistency requirement in the determination of the structure of the boson vacuum to be used. In this way one is allowed to use basic fermion representations which do not correspond to the actual shape of the system. Such a possibility becomes important in cases, where the shape of the system is not known beforehand, such as in the region of transition between spherical and deformed shape; and quite generally it allows a unified description of systems with different equilibrium shapes. Author

N68-10137# Purdue Univ., Lafayette, Ind. Dept. of Physics.
HIGH ENERGY PARTICLE PHYSICS Annual Progress Report, Jun. 1, 1966–May 31, 1967
G. W. Tautfest 12 Jul. 1967 19 p refs
(Contract AT(11-1)-1428)
(COO-1428-29) CFSTI: HC $3.00/MF $0.65

Various meson–nucleon and meson–deuteron interactions at high energies are described. Also various computer programs used in the data analysis are briefly mentioned. NSA

N68-10138# Purdue Univ., Lafayette, Ind. Dept. of Physics.
THEORETICAL STUDY OF INTERACTION OF ELEMENTARY PARTICLES Progress Report, Feb. 1, 1967–May 31, 1967
Masao Sugawara 12 Jul. 1967 12 p refs
(Contract AT(11-1)-1428)
(COO-1428-28) CFSTI: HC $3.00/MF $0.65

A summary of the research carried out, which consists of the completion of a comprehensive review of nonleptonic weak interactions and the initiation of research into infinite-component wave equations, is given. NSA

N68-10152* Oak Ridge National Lab., Tenn. Neutron Physics Div.
GAMMA RAYS FROM BOMBARDMENT OF ^{7}Li, Be, ^{11}B, C, O, Mg, Al, Co, Fe, AND Bi BY 16- TO 160-MeV PROTONS AND 59-MeV ALPHA PARTICLES
W. Zobel, F. C. Maienschein, J. H. Todd, and G. T. Chapman Nov. 1967 75 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-90052; ORNL-4183) CSCL 20H

Determining the contribution of secondary gamma rays to the radiation dose produced by charged particles in space requires a knowledge of the cross sections for gamma-ray production by protons and alpha particles. The only data of this type that has been available has been for ~145-MeV protons. In the experiment reported here gamma-ray spectral measurements were made for protons of 16, 33, 56, and 160 MeV and alpha particles of 59 MeV incident on targets of low- and medium-Z materials. Absolute spectra were obtained, generally in the backward direction, with coincidence (pair) or anticoincidence (total-absorption) scintillation spectrometers. The analysis method used to correct for the imperfect spectrometer response yielded quantitative error estimates for the spectra. A few measurements were made in the forward direction or at 90° to distinguish deviations from isotropy which were marked only for 16-MeV protons incident on a carbon target. From the spectra, cross sections were obtained for the production of specific gamma rays. Author

N68-10166 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
POSSIBILITIES OF USING ORGANIC SCINTILLATION DETECTORS IN MEASUREMENTS OF DOSE EQUIVALENT AND QUALITY FACTOR IN MIXED NEUTRON–GAMMA RADIATION [MOZLIWOSCI WYKORZYSTANIA ORGANICZNYCH SCYNTYLACYJNYCH DETEKTOROW DO POMIAROW ROWNOWAZNIKA DAWKI I WSPOLCZYNNIKA JAKOSCI PROMIENOWANIA MIESZANEGO NEUTRONOWEGO–GAMMA]
S. Pszona 1967 13 p refs
(INR-785/XIX/D)

The response of organic scintillation detectors in the mixed neutron–gamma radiation has been analyzed. It has been proved, that it is possible to use the new detectors system to measure dose equivalent and quality factor of mixed neutron–gamma radiation. The system consist with a tissue equivalent chamber and an organic scintillator. Some preliminary results were quoted. Author

N68-10167 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
METHOD OF ABSOLUTE GAMMA SOURCES ACTIVITY MEASUREMENT USING A SCINTILLATION COUNTER IN FIXED GEOMETRY [BEZWZGLEDNA METODA POMIARU AKTYWNOSCI ZRODEL PROMIENIOWANIA GAMMA ZA POMOCA LICZNIKA SCYNTYLACYJNEGO O STALEJ GEOMETRII]
K. Zarnowiecki 1967 17 p refs
(INR-799/XIX/NT)

It has been calculated that the efficiency of a gamma scintillation counter is lower than that obtained from a simple exponential formula. The influence of escape of the fluorescence X-rays and annihilation photons and the presence of low energy Compton electrons has been taken into account. It has been proved that a counter in collimated geometry can be used for the absolute measurements of gamma source activity. The method of calculating the correction factors for filters, and a collimator permeability is given. The experimental results agree very well with the theoretical calculations. Author

N68-10194# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron Physics.
A METHOD FOR STABILIZING PARTICLE ORBITS IN THE RACE-TRACK MICROTRON
H. Babic and M. Sedlacek 1 Aug. 1967 9 p refs Submitted for publication
(Rept.-67-14) CFSTI: HC $3.00/MF $0.65

Axial stability and synchronism of particle motion in the race-track microtron can be attained by a simple correction of the magnet fringing fields. The method proposed here consists of fringing field correction by an auxiliary pair of poles near the edge of the magnet sector. The effect of such a correction on orbit and phase stability is investigated for a two magnet sector microtron. The sectors are semicircular and no other corrections are included. Author (ESRO)

N68-10224# Joint Inst. for Nuclear Research, Dubna (USSR). Nuclear Problems Lab.

ON THE RATE OF THE SYNTHESIS REACTION IN A MESOMOLECULE DD μ WITH THE MOMENTUM 1 [O SKOROSTI REAKTSII SINTEZA V MEZOMOLEKULE DD μ S MOMENTOM 1]

E. A. Vesman 1967 12 p refs In RUSSIAN
(JINR-P4-3384)

The rate of a nuclear reaction in a mesomolecule $(dd\mu)^+$, which was formed in a state with momentum K=1, is estimated. It is found that the rate of the synthesis reaction from the p-state is of the same order as from the s-state, and its value is of the order 10^{10} to 10^{11} sec^{-1}. Author (NSA)

N68-10225# Uppsala Univ. (Sweden). Inst. of Physics.

THE SPECTRUM O(IV)

Jan Bromander May 1967 33 p refs
(UUIP-540)

The spectrum of triply ionized oxygen, was studied in the wavelength region 500 to 8000 Å. On the basis of the new measurements, made in this investigation and by Palenius (1967), together with a number of Edlen's (1934) lines below 500 Å, the term system was recalculated. The doublet and quartet systems are connected through four intercombination lines of the multiplet $2s^22p\ ^2P–2s2p^2\ ^4P$. The ionization limit was determined to be 624,383.7 cm^{-1} (77.417 eV). Author (NSA)

N68-10235*# Oak Ridge National Lab., Tenn.

ESTABLISHING AN ENERGY SCALE FOR PULSE-HEIGHT DISTRIBUTIONS FROM GAMMA-RAY SPECTROMETERS BASED ON INORGANIC SCINTILLATORS

R. W. Peelle and T. A. Love Oct. 1967 66 p ref
(NASA Order R-104; Contract W-7405-ENG-26)
(ORNL-4118) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Devices, experiment designs, and data analysis techniques for the calibration of scintillation gamma-ray spectrometers are critically examined. Though the ideas have broader application, the discussion assumes the use of NaI(Tl) phosphors. The review of calibration sources includes tables of gamma-emitting radioisotopes, with best energies, uncertainties, and other convenient data. The branching ratios among the naturally mixed X-ray lines (K–L vs K–M + K–N) are tabulated for useful radioisotope X-ray sources to enable use of a simple method given for determining the appropriate effective energy of the mixed source. The origins of spectrometer instability and nonlinearity, their relative importance, defensive experiment designs, and data analysis techniques are discussed. For finding the central position of the peak in a pulse-height distribution from gamma rays of a single energy, all standard numerical and graphical methods are reviewed, including full and partial nonlinear least-squares analyses. Finally, interpolation methods are detailed for determining from the available calibration information an unknown gamma-ray energy and its uncertainty. Author

N68-10252# Oak Ridge National Lab., Tenn.

THE BUILD-UP FACTOR B IN ATTENUATION CALCULATIONS OF γ RADIATION

Silvia Dumitrescu and V. Marghitu [1966] 4 p Transl. into ENGLISH from Acad. Rep. Populare Romine, Studii Cercetari Fiz. (Bucharest), v. 18, no. 4, 1966 p 445–446
(ORNL-TR-1640) CFSTI: HC $3.00/MF $0.65

Gamma-ray experiments with radioisotopes require a careful selection of the source–absorber–detector geometry in order to describe the attenuation by a law that can be expressed analytically. In order to facilitate the design of radiation shields, a new calculation method was developed; it yielded results with an error not exceeding 20% even when considering the dose rate of sealed sources. Introduction of the buildup factor B into the calculations makes it unnecessary to use arbitrary safety coefficients. The study is based on the examination of ^{60}Co and ^{137}Cs sources with energies of 1.25 and 0.66 MeV, respectively; it involved determination of the dose rates at various distances and for various thicknesses of absorbers, such as lead, iron and concrete. The results are presented in the form of nomograms plotted with and without taking the buildup factor into consideration. Use of these nomograms allows one to avoid complex calculations. When measuring the dose rate with G-M counters, the calibration curve of the energy range in question must be taken into account. NSA

N68-10276# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

QUARK MODEL AND HIGH ENERGY PRODUCTION PROCESSES

H. Satz Jun. 1967 7 p refs
(DESY-67/19)

The additivity assumption for quark constituents in hadronic reactions is applied to high-energy production processes. It is shown that this assumption together with a statistical model for quark–quark production reactions leads to a simple picture which successfully describes the essential aspects of nonannihilation production reactions. Author (NSA)

N68-10287# California Univ., Berkeley. Lawrence Radiation Lab.

AN EPR STUDY OF THE $O_2(^1\Delta_g)$ MOLECULE

Arnold M. Falick (Ph.D. Thesis) Jun. 1967 83 p refs Sponsored in part by NSF
(Contract W-7405-ENG-48)
(UCRL-17453) CFSTI: HC $3.00/MF $0.65

The 4-line EPR spectrum of the J=2 level of the $O_2(^1\Delta_g)$ molecule in discharged oxygen produced in a 13.56 MHz discharge-flow system was measured and analyzed. The calculated spectrum gives an excellent fit to the experimental one by using g_J = −0.66662. Transition matrix elements were calculated for the $O_2(^1\Delta_g)$ EPR transitions so that absolute concentration measurements could be made. The rate of the reaction $O_2(^1\Delta_g) + O_2(^1\Delta_g) \rightarrow 2\ O_2(^3\Sigma_g^-) + h\nu$ (6340 A) was measured as a function of pressure over range 0.1 to 1.0 torr and in mixtures of oxygen with up to 75% of He and Ar. The 6340 Å emission, which was detected with an interference filter and a photomultiplier, was found to be second order with respect to $O_2(^1\Delta_g)$ concentration under all of the experimental conditions used. The $O_2(^1\Delta_g)$ concentration was determined from the intensity of one of its EPR lines, and absolute concentrations were calculated by comparison with $O_2(^3\Sigma_g^-)$ ground-state EPR lines. The second-order rate constant for the reaction did not change with pressure or added gas and was found to be $k_1 = 5.0 \pm 0.5 \times 10^{-23}$ cm^3/molecule-sec, compared to the value of $k_1 = 2.3 \times 10^{-22}$ cm^3/molecule-sec obtained by Ogryzlo, et al. The results suggest that the reaction occurs via an O_4^* intermediate, which is simply a colliding pair of

excited oxygen molecules. In addition it was found that $O_2(^1\Delta_g)$ is primarily formed in the discharge and that it reacts slowly or not at all with NO or NO_2. Author (NSA)

N68-10292# Brookhaven National Lab., Upton, N. Y.
EFFECT OF SCATTERING ANISOTROPY ON THE CALCULATION OF PULSED-NEUTRON DECAY CONSTANTS
J. Dorning (Columbia Univ., New York) Jul. 1967 26 p refs
(BNL-11560) CFSTI: HC$3.00/MF$0.65

The effect of including various orders of scattering anisotropy in the calculation of pulsed-neutron (die-away) experiment discrete time-decay constants is examined. The fundamental mode thermal neutron decay constants for spherical light water systems are computed using realistic scattering models for the bound hydrogen atoms of the H_2O molecule. Comparison with experiment shows that retention of the linearly anisotropic (P–1) term in the scattering kernel is essential. The inclusion of higher-order scattering anisotropies (P-2, P-3), however, leads to extremely small changes in the computed decay constants. As demonstrated by the calculations, the isotropic scattering approximation underestimates the leakage, whereas the P–1 approximation results in a rather accurate determination of this dominating factor. The use of "transport-corrected" P–0 cross sections results in accurate values for the decay constants of systems in the experimental range, and the computations show that this method of accounting for scattering anisotropy is adequate for decay-constant calculations in H_2O. Additional information obtained from the calculations include the space-dependent energy spectra. Author (NSA)

N68-10295# Illinois Univ., Urbana. Dept. of Physics.
THE REACTION $K^-d \rightarrow K^0nn$, FROM THRESHOLD TO 300 MeV/c. PART 1. K^+p ELASTIC SCATTERING: 80 TO 280 MeV/c, PART 2
Robert Maurice Lansford (Ph.D. Thesis) 1967 97 p refs
(Contract AT(11-1)-1195)
(COO-1195-87) CFSTI: HC$3.00/MF$0.65

The cross section for the interaction $K^- + d \rightarrow K^0 + n + n$ was measured for the laboratory momentum interval from threshold (96.7) to 300 MeV/c. The cross section is found to rise quickly above threshold to around 6 mb at 150 MeV/c, then decrease slowly from 150 to 300 MeV/c. This cross section is consistent with even parity and agrees reasonably well with recent three-body calculations. Angular distributions were presented which indicate that low partial waves are taking part. An experiment was also performed using the hydrogen bubble chamber to measure the low-energy $K^+ + p$ elastic scattering cross section. The differential cross section is found to be flat and to vary little with increasing momentum. NSA

N68-10296 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
SUM RULES IN QUANTUM MECHANICS
E. M. Ferbeira and J. Sesma (Univ. Central de Venezuela) 1967 30 p refs *Its* Notas de Fisica, vol. 12, no. 20

The sum rules usually derived for the squares of the matrix elements of the co-ordinate operator between eigenstates of a Schrödinger Hamiltonian are here extended to the matrix elements of more general operators taken between the states of any complete set of states. For that purpose extensive use is made of the closure relation for the set of eigenstates of a hermitian operator. Several applications of the sum rules obtained are made. Author

N68-10333# Los Alamos Scientific Lab., N. Mex.
NEUTRON–DEUTERON SCATTERING LENGTHS AND THE S-WAVE PHASE SHIFTS
John D. Seagrave and W. T. H. van Oers (Calif. Univ., Los Angeles) [1967] 18 p refs Presented at the Symp. on Light Nuclei, Few Body Probl., and Nucl. Forces, Brela, Yugoslavia Sponsored jointly by ONR
(Contract W-7405-ENG-36)
(LA-DC-8857; CONF-670629-3) CFSTI: HC$3.00/MF$0.65

New data on coherent and incoherent neutron–deuteron scattering permit re-evaluation of the doublet and quartet scattering lengths, with the results $^4a = 6.14 \pm 0.06$ fm, and $^2a = 0.11 \pm 0.07$ fm. These values imply $\sigma_{free} = 3.14 \pm 0.06$ barns. A comparison is made with the values obtained from extrapolations of the ^4S and ^2S phase shifts for n–D and p–D elastic scattering. For the n–D ^2S phase shift $^2\delta_0$, the effective-range representation of $k \cot(^2\delta_0)$ exhibits a term with a "pole" at a negative energy corresponding to $E_{lab} \approx -0.1$ MeV. Author (NSA)

N68-10359# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CALCULATIONS OF SINGLE-PARTICLE STATES OF DEFORMED NUCLEI [O TOCHNOSTI VYCHISLENIYA ODNOCHASTICHNYKH SOSTOYANII DEFORMIROVANNYKH YADER]
F. A. Gareev, S. P. Ivanova, and B. N. Kalinkin 1967 10 p refs In RUSSIAN Submitted for publication
(JINR-P4-3326)

The method of calculating single-particle states depends on diagonalization of the energy matrices to simplify the calculations. The states of the spherical nucleus having a corresponding mass and an average nuclear field described by a Saxon–Woods potential are used as a base. The wave functions of the states of the spherical nucleus can be represented in analytical form. A program for calculating the single-particle states of deformed nuclei on a computer was developed. The accuracy of the results was estimated by comparing the computation with the data of other authors who developed a more accurate method calculation which was based on a numerical solution of the set of differential equations. The single-particle levels were calculated as a function of the deformation β with the change in the spin-orbit interaction being taken into account. In most cases the agreement was excellent. The advantage of the proposed method was that the calculations could be carried out about a factor of 100 faster. NSA

N68-10360# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
SCATTERING OF THE EV NEUTRONS BY WATER MOLECULES [RASSEYANIE ELEKTRONVOL'TNYKH NEITRONOV MOLEKULAMI VODY]
G. S. Samosvat, Yu. S. Sayasov, and V. T. Chuburkov 1967 15 p refs In RUSSIAN
(JINR-P3-3413)

A doubly differential cross section of neutron scattering by molecules was measured using a method based on fixing the final energy of the scattered neutrons by a resonance detector (neutron resonance of gold at an energy 4.91 eV was used). The results of the measurement of scattering by water confirm a model, according to which the bound nucleus behaves itself as a quasi-free one while scattering eV neutrons. Author (NSA)

N68-10372# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ANHARMONIC EFFECTS IN EVEN–EVEN DEFORMED NUCLEI [ANGARMONICHESKIE EFFEKTY V CHETNO–CHETNYKH DEFORMIROVANNYKH YADRAKH]

R. V. Dzholos, V. G. Solov'ev, and K. M. Zheleznova 1967 8 p refs In RUSSIAN Submitted for publication
(JINR-P4-3432)

The admixture of the two-phonon states to the lowest one-phonon states in even–even deformed nuclei removed from the transition regions is considered. It is shown that this admixture is small. It means that the anharmonic effects are not important in even–even deformed nuclei. Author (NSA)

N68-10373# Oak Ridge National Lab., Tenn. Isotopes Div.
EXPERIMENTAL STUDY OF EXCITED LEVELS OF ^{132}Xe
R. Henck, L. Stab, P. Siffert, and A. Coche 1967 14 p refs Transl. into ENGLISH from Nucl. Phys., v. A93, 1967 p 597–608
(ORNL-TR-1683) CFSTI: HC$3.00/MF$0.65

The γ spectrum of ^{132}I was studied with Ge(Li) γ spectrometers. The following previously unreported transitions were observed: 813 ± 2, 864 ± 3, 877 ± 2, 911 ± 2, 926 ± 3, 1034 ± 3, 1291 ± 2, 1296 ± 2, 1316 ± 2, 1828 ± 3, 2088 ± 3, 2250 ± 3, 2286 ± 3, 2445 ± 3, and 2524 ± 3 keV; the relative intensities were measured. Previously published values of relative K-electron intensities were used to obtain the conversion coefficients for the 263, 285, 504, 507, 523, 620, 630, 727, 729, 773, 955, 1138, and 1398 keV transitions. All are M1 and/or E2 except the 504(E1) and 729 (M2 or E3) keV transitions. The level scheme proposed by Hamilton, Boyd and Johnson is modified; the level at 2658 keV is suppressed, and levels are added at 2351, 2393, 2428, 2590, 2614.4, 2670 and 2892 keV. Author (NSA)

N68-10389# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SCATTERING OF POSITRONS AND ELECTRONS FROM PROTONS
W. Bartel, B. Dudelzak, H. Krehbiel, J. M. McElroy, R. J. Morrison et al Jul. 1967 12 p refs
(DESY-67/22)

The result of an experiment in which the ratio of the elastic scattering cross section for positrons and electrons on protons was measured at momentum transfers of $q^2 = 11.66$ and $35.1\ f^{-2}$ is reported. This experiment was performed at $q^2 = 35.1\ f^{-2}$. In order to determine a possible q^2-dependence of R, a measurement was also made at $q^2 = 11.66\ f^{-2}$. No indication of a contribution to the cross section of a two-photon amplitude was found. NSA

N68-10390# Bonn Univ. (West Germany).
ON THE STRUCTURE OF V-48 [ZUR STRUKTUR DES VANADIUM 48]
H. W. Flender Jun. 1967 95 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-67-59)

The g-factor of the 304-keV state of ^{48}V was determined by observing the rotation of the 116 keV–305 keV $\gamma\gamma$ angular correlation in strong external magnetic fields. Liquid sources as well as ^{48}Cr sources embedded in a lattice of metallic copper were used for these measurements. Within the limits of error the same rotation was found for both sources. The result $g = +0.188 \pm 0.017$ disagrees with the predictions of the $f_{7/2}$-model of McCullen et al. but may be explained in the Nilsson model. Author (NSA)

N68-10391# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
QUANTUM THEORY OF SCALAR FIELD IN THE TWO-DIMENSIONAL DE SITTER SPACE [KVANTOVAYA TEORIYA SKALYARNOGO POLYA V DVUMERNOM PROSTRANSTVE DE SITTERA]
E. A. Tagirov, E. D. Fedyun'kin, and N. A. Chernikov 1967 21 p refs In RUSSIAN
(JINR-P2-3392)

The Fock representation is introduced for the quantum scalar field in the two-dimensional de Sitter space-time. The vacuum and n-particle states were determined. It is shown that the particles considered are not produced and annihilated in spite of the metric being nonstationary. A state of the particle is characterized by the discrete quantum number owing to the space compactness. Author (NSA)

N68-10392# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
FREE LOCAL FIELDS WITH INFINITE MULTIPLETS
Cao Chi and Nguyen van Hieu 1967 12 p refs Submitted for publication
(JINR-E2-3430)

The possibility of the existence of free local fields involving infinite multiplets with the conventional relation between spin and statistics in the symmetry theory with noncompact groups is considered. It is shown that such fields exist and the field energy derived from the Lagrangian is positive definite. The amplitudes of crossing processes satisfy the Low substitution rule. Author (NSA)

N68-10394# California Univ., Livermore. Lawrence Radiation Lab.
G FACTOR OF THE 243-KEV LEVEL IN ^{89}Y
William J. Treytl and E. Matthias Jun. 1967 12 p refs Presented at the Intern. Conf. on Hyperfine Interactions, Pacific Grove, Calif., 25–30 Aug. 1967
(Contract W-7405-ENG-48)
(UCRL-17636; CONF-670812-6) CFSTI: HC$3.00/MF$0.65

The g-factor and half life of the 243 keV 2^- state in ^{89}Y were measured. The values obtained are $g = -0.53 \pm 0.03$ and $t_{1/2} = 28.5 \pm 2.1$ nsec. The g-factor favors the configuration $[(g_{1/2})_\pi (d_{5/2})_\nu]_{2-}$. Author (NSA)

N68-10406# Sandia Corp., Albuquerque, N. Mex.
NEUTRON SPECTROSCOPY BY FOIL ACTIVATION IN RADIATION EFFECTS STUDIES
J. A. Halbleib, J. V. Walker, and C. L. Greer Jul. 1967 28 p Presented at the Nucl. and Space Radiation Effects Conf., Columbus, Ohio
(Contract AT(29-1)-789)
(SC-DC-67-1572; CONF-670708-2) CFSTI: HC$3.00/MF$0.65

A technique for obtaining spectral information from foil-activation data is described. The technique is based upon the determination of an iterative algorithm that arises from the minimization of a least squares error. NSA

N68-10417 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
THE WIDTH $\eta \to 2\gamma$ AS A TEST OF THE MASS FORMULA FOR BOSON NONETS
G. De Franceschi, F. Guerra, V. Silvestrini, and F. Vanoli 25 Jul. 1967 7 p refs *Its* Nota Interna No. 376
(LNF-67/53)

The width of the decay $\eta \to 2\gamma$ which was experimentally found to be $\Gamma\ \eta \to 2\gamma = (1.21 \pm 0.26)$ KeV, was used as a mathematical prediction test of the mass formula for boson nonets. Solutions obtained by the present model were compared to

solutions obtained by the pole dominance model of Gell-Mann, Sharp, and Wagner (GSW model). Results indicate that the GSW model does not work satisfactorily for the case considered; and that use of the present model is more desirable. L.S.

N68-10421# Forsvarets Forskningsanstalt, Stockholm (Sweden).
HYDROGEN ISOTOPE FUSION REACTIONS BY MUON CATALYSIS [KATALYS MED MYMESONER AV FUSIONS-REAKTIONER MELLAN VAETEISOTOPER]
H. Snellman Oct. 1966 56 p refs In SWEDISH
(FOA-4-4266-21)

During the past half decade information on experimental fusion reactions of hydrogen isotopes induced by muon catalysis has considerably increased. A review is given on the state of the art on the subject from reported experiments and theoretical calculations. These calculations are also extended to fusion reactions of tritium. The possibilities of gaining usable amounts of power are once more discussed. The conclusion is that this would probably not be possible. Author (NSA)

N68-10423# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
COHERENT BREMSSTRAHLUNG AND PAIR PRODUCTION ON DIAMOND SINGLE CRYSTALS [KOHAERENTE BREMSSTRAHLUNG UND PAARBILDUNG AN DIAMANT-EINKRISTALLEN]
Gerhard Lutz Jul. 1967 82 p refs In GERMAN
(DES4-67/23)

Quantum Electrodynamics predicts modifications of the bremsstrahlung and pair-production cross sections with respect to the cross sections for single atoms when crystal targets are used. In addition, the bremsstrahlung photons should be linearly polarized, and the pair-production cross section should depend on the linear polarization of the photons. All these effects were quantitatively proved by experiment and compared with the theory. A theory of the influences effects of target thickness and collimation on the bremsstrahlung spectrum was developed in order to make possible a comparison of the experimental results with theory. The experimental results obtained for bremsstrahlung and pair-production cross sections are in agreement with theory. The polarization of bremsstrahlung was measured using the dependence of the pair-production cross section on photon polarization. Good agreement with theory is found for various photon energies and polarization degrees; thus the polarization of bremsstrahlung as well as the polarization dependence of the pair-production cross section are shown to have been correctly predicted by theory. A method was found of producing photons having a very high degree of linear polarization. Author (NSA)

N68-10424# California Inst. of Tech., Pasadena. Synchrotron Lab.
BEAM ENERGY METER AND BEAM ENERGY CONTROL
J. O. Maloy 4 Aug. 1967 62 p refs *Its* Internal Rept. No. 34
(Contract AT(11-1)-68)
(CALT-68-139) CFSTI: HC$3.00/MF$0.65

The Beam Energy Meter indirectly measures the energy of the internal electron beam in the Synchrotron. The quantity actually measured is the magnetic flux in a pickup coil of known area placed at a known radius between the pole tips of the main guide magnet. The Beam Energy Meter integrates the output voltage of the pickup coil and provides a visual digital indication of the integral (the flux). The Beam Energy Control is used to control the voltage applied to the Synchrotron magnet so that the energy may be kept constant within about ±1 MeV (±0.07%). The main generator voltage regulator system controls the energy to about ±1% (±15 MeV at full energy). The Beam Energy Control adds a small correction into the regulator loop to achieve the desired ±1 MeV. The correction is computed by comparing the digital output of the Beam Energy Meter with the output of a 4 decade thumbwheel switch set to the desired energy. The analog control signal is obtained by rectifying and averaging a pulse-width-modulated 400 Hz square wave superimposed upon a 25.6 kHz carrier. Author (NSA)

N68-10427 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
ON THE COVARIANCE OF EQUAL TIME COMMUTATORS AND SUM RULES
C. G. Bollini, J. J. Giambiagi, and J. Tiomno 1967 20 p refs *Its* Notas de Fisica, vol. 13, no. 5

Conditions for covariance of equal time commutators are given. In momentum space they imply relations among the invariant amplitudes. It is shown that the most general expression for the sum rule, in any particular frame, is a form factor with an arbitrary time-like vector. The covariance conditions are expressed by the fact that the integral is n-independent. In particular, Fubini's sum rule, which corresponds to a choice of n in the light cone, in spite of being covariant must be supplemented with a set of covariance conditions. Author

N68-10439 Australian National Univ., Canberra. Inst. of Advanced Studies.
WEAK INTERACTION OF ELEMENTARY PARTICLES
M. Nakagawa Oct. 1966 97 p refs
(NP-16978)

The topics covered by these lectures are the concept of a weak universal interaction, the establishment of a P violating V–A law, CPT transformations and theorem, G transformation, CP violation, the concept of lepton number and its conservation, the neutrino and Pauli–Toushek transformation, the two-neutrino transformation, and μ–e universality. Also covered are CVC theory, the generalization to a unified scheme of weak interactions, the Goldberger–Trieman relation for $\pi \rightarrow \mu + \nu$ decay, interpretations of the Goldberger–Trieman relation, soft pion theory, current algebra, the Alder–Weisberger sum rule, renormalization of the strangeness-changing current, meson (K) leptonic decays, and the nonleptonic interaction. NSA

N68-10441# Rome Univ. (Italy).
RADIATIVE CORRECTIONS TO LEPTONIC DECAYS AND COMPOSITE MODELS FOR STRONG INTERACTIONS
N. Cabibbo, L. Maiani, and G. Preparata 19 Jun. 1967 20 p refs *Its* Internal Note No. 127
(NP-16941)

On the basis of the requirement of finite radiative corrections for leptonic decays, the abandonment of the quark model for strong interactions, in favor of models based on integrally charged triplets is proposed. A model of this kind—the SUB model—is discussed. This model is based on a proposal of Han and Nambu in which most of the results of the nonrelativistic quark model hold. Author (NSA)

N68-10445# California Univ., Livermore. Lawrence Radiation Lab.
THE APPLICATION OF ANALYTICITY PROPERTIES TO THE NUMERICAL SOLUTIONS OF THE SCHROEDINGER AND BETHE-SALPETER EQUATIONS

Richard Webb Haymaker (Ph.D. Thesis) 13 Jul. 1967 104 p refs
(Contract W-7405-ENG-48)
(UCRL-17652) CFSTI: HC$3.00/MF$0.65

A new method of calculating phase shifts from the Bethe–Salpeter equation is presented. The differential equation is solved below threshold using a variational method and then the scattering amplitude is continued to the physical scattering region using Pade approximants. The singularity structure of the Schrödinger and Bethe–Salpeter amplitudes in their off-shell variables was studied to find the nearby singularities that could most strongly affect the continuation. A variational method of calculating Regge trajectories in potential theory is presented. The variational equations are derived in the bound state region and then continued directly to all values of angular momentum and energy. Author (NSA)

N68-10457# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
COMPARISON OF METHODS FOR OBTAINING DANCOFF CORRECTIONS
G. L. Simmons and W. L. Purcell 20 Mar. 1967 20 p refs
(Contract AT(45-1)-1830)
(BNWL-CC-1099) CFSTI: HC$3.00/MF$0.65

Dancoff corrections obtained by the original Dancoff–Ginsburg computational methods are compared to those obtained by substituting an approximating formulation for the integral parts of the equations. The equations are computerized and results are compared. Tables of values for resonance integrals, Dancoff correction values, and k_∞ are presented. NSA

N68-10461# Oak Ridge National Lab., Tenn.
DIRECT-INTERACTION PROTONS EMITTED FROM Ag AND Au TARGETS BOMBARDED WITH 91- AND 156-MeV PROTONS
C. Brun, H. Dubost, B. Gatty, M. Lefort, and X. Tarrago [1967] 22 p Transl. into ENGLISH from Nucl. Phys., v. A95, 1967 p 337–356
(ORNL-TR-1685)

Angular and energy distributions were measured for prompt protons emitted between 4 and 150 MeV after the bombardment of Ag and Au targets by 156- and 91-MeV protons. The experimental device is a telescope made of 4 dE/dx and E solid-state counters. The energy distributions obtained in the forward angles are compared with the results obtained after Monte Carlo calculations on a large number of nucleon–nucleon quasi-elastic collisions inside the nuclear matter. Three models were used in the calculation; the impulse approximation was assumed for all three. One model is based on a square well potential. Both model 2 and model 3 assume a diffuse-edge nucleus. Model 2 (step) takes account of transmission coefficients by a classical refraction approximation. Model 3 (step no) does not include any effect of refraction or reflection. The comparison with experimental data shows that prompt cascade protons are emitted at a large rate even for an incident energy of 91 MeV. The proportion of compound nucleus is much lower than the calculated value by model 2. In many respects the best fit seems to be obtained with model 3, so called step no. The complete set of experimental data might stimulate more elaborated calculations on the direct process. Author (NSA)

N68-10463# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
CHARGED PION PRODUCTION IN 600 MeV NEUTRON COLLISIONS WITH NUCLEI OF DIFFERENT ELEMENTS. I: EXPERIMENT [OBRAZOVANIE ZARYAZHENNYKH PIONOV PRI SOUDARENIYAKH NEITRONOV S ENERGIEI 600 MeV S YADRAMI RAZLICHNYKH ELEMENTOV. I: EKSPERIMENT]
K. O. Oganesyan 1967 29 p refs In RUSSIAN
(JINR-P1-3399)

Charged pion production in the collisions of neutrons with Be, C, Al, Cu, and Pb nuclei was investigated by a magnetic spectrometer in the large angle region. The pion spectra of both signs are obtained on these nuclei at the angles 16, 30, 60, 90, and 123°. The cross sections, atomic number dependencies and angular characteristics of the pion production are found with the aid of these spectra. Author (NSA)

N68-10465# California Univ., Los Angeles. Dept. of Physics.
RESEARCH PROGRAM OF THE UCLA CYCLOTRON LABORATORY
J. Reginald Richardson and Byron T. Wright Jul. 1967 133 p refs
(Contracts Nonr-233(44); N00014-67-A-0111-0009; AT(11-1)-GEN-10)
(AR2; AD-659389) CFSTI: HC$3.00/MF$0.65

Partial contents: Nucleon–nucleon Bremsstrahlung; Investigations of the p + d reactions; Angular distribution of the d(p,n)2p reaction; Investigations of the p + He3 reactions; Elastic scattering; Polarization measurements; Inelastic scattering; Study of the few nucleon pickup; The reaction Y89(p,2p)Sr88; Total proton reaction cross sections of light nuclei; Nuclear Bremsstrahlung; Alpha, beta and gamma spectroscopy; Few nucleon problems; Optical model analysis; Parameter study of the distorted wave theory in the C12(p,2p)B11 reaction; Proton dosimetry. TAB

N68-10474# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
MULTIGROUP TWO-DIMENSIONAL NEUTRON TRANSPORT
Bruce W. Crawford and Jack P. Friedman [1966] 27 p refs Presented at the 13th Ann. Meeting of the Am. Nucl. Soc., San Diego, Calif., 11–15 Jun. 1967
(Contract W-31-109-ENG-52)
(KAPL-P-3365; CONF-670602-25) CFSTI: HC$3.00/MF$0.65

A multigroup formulation of the two-dimensional transport equation with forward and isotropic scattering components is presented together with applications of the iterative method for solving the equation. NSA

N68-10477# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
EFFECT OF PERIODIC AND RANDOM PERTURBATIONS ON NON-LINEAR SYSTEMS [VLIYANIE PERIODICHESKIKH I SLUCHAINYKH VOZMYSHCHENII NA NELINEINYE SISTEMY]
A. S. Bakai 1966 89 p refs In RUSSIAN
(FTI-102/T-035)

Phenomena due to nonlinearity, however small the nonlinearity is, are qualitatively different from phenomena in linear systems. Methods of solving nonlinear equations, which were developed by Puankare, Lyapunov, Krylov–Bogolyubov, and others are reviewed. Most of these methods involve a series containing a slowly changing variable. For example, a typical example involves the effect of a sinusoidal force with a slowly varying frequency and amplitude on a nonlinear oscillator. The phase behavior and the position of particular points on the phase surface are given. The effect of an applied sinusoidal force on a nonlinear oscillator is also considered in the presence of random perturbations. Resonance in a nonlinear system in the presence of random impulses, spectral density, average half-life of particles in an accumulator, leakage of particles from an accumulator due to the quantum nature of the radiation or due to instability of amplitude and frequency of the compensating

field, and stabilization of systems with nonlinear friction are types of problems that are solved by nonlinear mathematical methods. NSA

N68-10481# Deutsche Akademie der Wissenschaften zu Rossendorf (East Germany).
COMPARISON OF (d,p) AND (n,γ) REACTIONS ON THE ODD–ODD NUCLEI ^{40}K, ^{46}Sc, ^{52}V, AND ^{60}Co [DER VERGLEICH VON (d,p)- UND (n,γ)- REAKTIONEN AN DEN UU-KERNEN K^{40}, Sc^{46}, V^{52} UND Co^{60}]
Werner Rudolph Jan. 1967 78 p refs In GERMAN
(ZfK-PhA-24)

The high-energy γ radiation which is emitted after the capture of thermal neutrons by the odd–odd nuclei ^{40}K, ^{46}Sc, ^{52}V, and ^{60}Co was measured. The experimentally reduced intensities $1_\gamma/E_\gamma^3$ of the primary γ transition were compared with the probabilities for the population of the same levels in the (d,p) reaction. This comparison shows that in the (n,γ) reaction many levels with large constituents of a single-particle excitation of the neutron group were very strongly populated by primary γ transitions. However, very intensive primary γ transitions were observed to the states which in the (d,p) reaction were only very weakly excited and which therefore can contain only slight fractions of the configuration "target ground state + single neutron". The experimental transition probabilities were interpreted in the framework of a model in which the γ transitions were described as single-particle transition and core excitation was considered. A study was made to determine which correlations in the direct capture of neutrons are to be expected in the (n,γ) reaction. In the framework of the model used it was shown that in this case a rigid correlation of the (relative) transition probabilities in both reactions should be ascribed to neutron p-states. A detailed comparison of the experimental transition probabilities shows that this type of correlation is not present. Author (NSA)

N68-10482# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
EFFECT OF LOCAL INHOMOGENEITIES OF THE MAGNETIC FIELD ON PARTICLE MOTION IN SPACE VARIATION ACCELERATORS [VLIYANIE LOKAL'NYKH NEODNORODNOSTEI MAGNITNOGO POLYA NA DVIZHENIE CHASTITS V USKORITELYAKH S PROSTRANSTVENNOI VARIATSIEI]
V. P. Dmitrievskii, T. M. Prilipko, and V. S. Rybalko 1967 33 p refs In RUSSIAN
(JINR-P9-3434-1)

The effect of the gradient local inhomogeneities of the magnetic field on particle motion in space variation accelerators is investigated on the basis of the matrix method. The possibilities of using such perturbations for beam extraction by the resonance method are considered. Author (NSA)

N68-10485# Brookhaven National Lab., Upton, N. Y. Information Div.
VIOLATION OF T-INVARIANCE IN RESONANCE SCATTERING OF PHOTONS BY NUCLEI
N. A. Burgov and G. A. Lobov Mar. 1967 13 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 52, 1967 p 527–532
(BNL-TR-137) CFSTI: HC$3.00/MF$0.65

T-odd angular correlation in resonance scattering of photons by polarized nuclei is calculated. The effect of an external magnetic field on the correlation is taken into account. Numerical values of the correlation coefficients are presented for a large number of nuclei. The experimental data and predictions of various hypotheses regarding the degree of violation of T-parity in processes involving hadrons are discussed. The problem of experimental investigation of T-odd angular correlation by means of the Mössbauer effect is discussed. Author (NSA)

N68-10487# Brookhaven National Lab., Upton, N. Y.
CONVERGENT, BOUNDING, APPROXIMATION PROCEDURES WITH APPLICATIONS TO THE FERROMAGNETIC ISING MODEL
George A. Baker, Jr. 1965 9 p refs Presented at the Intern. Congr. on Magnetism, Boston
(BNL-11648; CONF-670921-1) CFSTI: HC$3.00/MF$0.65

The Padé approximant method is generalized in such a way that converging upper and lower bounds can be established from the early power series coefficients for a wider class of functions than was previously possible. These procedures are proved to be applicable to many thermodynamic properties of the ferromagnetic Ising model and used thereon. Although nonbounding calculational procedures are shown to be satisfactory for most states of the system, certain pitfalls of those procedures are noted near the critical points. Author (NSA)

N68-10488# Brookhaven National Lab., Upton, N. Y.
MAGNETIC MOMENT OF THE $D_{3/2}$ HOLE STATE IN Sc^{47}
D. B. Fossan (State Univ. of N. Y., Stoney Brook) and A. R. Poletti 1966 14 p refs Presented at the Intern. Conf. on Hyperfine Interactions, Pacific Grove, Calif.
(BNL-11643; CONF-670812) CFSTI: HC$3.00/MF$0.65

The magnetic moment of the 760-keV level in ^{47}Sc was measured, using the ^{44}Ca(α,p)^{47}Sc reaction and the differential time-delay technique, to be $\mu = (0.35 \pm 0.05)\mu_N$. A half-life of 269±12 nsec was also obtained from the results for this level. This magnetic moment result is consistent with an interpretation for this level of no core-excitation admixtures in the $d_{3/2}$ hole wave function. Author (NSA)

N68-10489# Paris Univ., Orsay (France). Inst. of Nuclear Physics.
SOLUTION OF THE NUCLEAR HARTREE–FOCK EQUATIONS IN COORDINATE SPACE
D. Vautherin and M. Veneroni Jul. 1967 12 p refs
(IPNO/TH-91)

A method is proposed which permits the direct numerical solution of the Hartree–Fock equations for spherical nuclei is proposed. The idea is to replace the nonlocal one-body potential occurring in the Schroedinger equation by a local potential which is state-dependent. The usual HF iteration process is then replaced by a double iteration. The method is simple only with a local two-body interaction. Results of calculations for oxygen-16 and calcium-40 are given using this method. NSA

N68-10490# Akademiya Nauk URSR, Kiev. Institut Theoreticheskoi Fiziki.
BARYON MAGNETIC MOMENTS AND ALGEBRA OF CURRENTS
M. Cini, M. De Maria, and B. Taglienti 1967 9 p refs Submitted for publication
(ITF-67-5)

The problem of magnetic moments is reinvestigated for the purpose of determining whether the system of all the independent algebraic equations between matrix elements of currents, obtained by taking into account in the commutators the contribution of an SU(3) singlet state in addition to the octet and decuplet states, has a nonvanishing consistent solution. The interest is primarily in the symmetry properties of the solution which follow from the constraints imposed by the existence conditions. It was found that the minimal truncated set of intermediate states leading to a nonvanishing result for the magnetic moments contains, besides octet and decuplet, also an SU(3) singlet. The symmetry derived from the algebra U(3) for the weak constants and the magnetic moments with such an approximate saturation, namely, SU(3) with D/F = 3, seems therefore a better approximation than the SU(6) symmetry obtained with octet and decuplet saturation of the U(3) algebra of axial charges. NSA

N68-10495# Alabama Univ., University. Dept. of Physics.
INDUCED EFFECTS IN BETA DECAY AND MUON CAPTURE Final Technical Report, Mar. 1965–Aug. 1967
James N. Huffaker and Christopher E. Laird Sep. 1967 46 p refs
(Grant DA-ARO(D)-31-124-G684)
(TR-3; AD-659398)

In order to facilitate analysis of muon capture in 16O, results are presented of a shell-model calculation of low-lying odd-parity states of 16O and 16N, including the effects of a two-particle spin-orbit interaction. Calculated energy levels and rates for various beta-decay and muon-capture transitions are given as functions of the spin-orbit interaction strength. Formulas are obtained for single-level muon-capture rates for the following transitions: 12C(0+) 12B(1+); 16O(0+) to 16N(0-); 16O(0+) to 16N(1-); and 16O(0+) to 16N(2-). The formulas include effects of finite nuclear size and relativistic treatment of the muon, and are presented in a form showing explicit dependence on induced form factors and on configuration-mixing coefficients for the various nuclear levels. Electron radial wave functions suitable for beta-decay calculations involving light elements ($Z < 10$) are presented for an absolute value of kappa of $<$ or $=$ 2. These functions are then applied to the first-forbidden unique decay of 16N and to the various decays of 14C and 14O. The analyses of the mass-14 system, not yet completed, could provide important information about nuclear matrix elements and shell-model states for these nuclei. TAB

N68-10500 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
PHOTONUCLEAR REACTIONS IN CARBON AT ENERGIES BETWEEN 300 MeV AND 1000 MeV
V. Di Napoli, F. Dobici, O. Forina, F. Salvetti, and H. G. de Carvalho 1967 24 p refs *Its* Notas vol. XIII, no. 3

In the energy range from 300 Mev up to 1000 Mev, cross-sections for the reactions $^{12}C(\gamma, n)^{11}C$ and $^{12}C(\gamma, x)^{7}Be$ have been measured using bremsstrahlung beams of the Frascati electronsynchrotron by means of the activation method. The (γ, n) cross-section measured, 1.18 ± 0.20 mbarn, is in agreement with the predicted from the photomeson model. The $^{12}C(\gamma, x)^{7}Be$ cross-section found was $8 \pm 4 \times 10^{-29}$ cm^2. Author

N68-10513 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
P–P ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFERS
E. Etim and M. Greco 23 Aug. 1967 11 p refs *Its* Nota Interna No. 377
(LNF-67/59)

Objections are offered to the onion-shape theory of the nucleon structure which proposes that the proton consists of different sheets surrounding a central core, and to the threshold which sees in the breakpoint (kink) the onset of baryon and antibaryon production. In the case of the collision of two protons, questions are raised as to which of these particles must be considered as a probe particle which gives detailed information through scattering on the onion structure of the other, and what is the physical meaning of the sheet radii. The point is made that it is the dependence on the variable S $\sin\theta$ and not the appearance of a kink which should claim more attention. The Orear formula is plotted, and it is shown that for $\theta \approx 90°$ the experimental points are better fitted by the smooth curve than by an indeterminate number of straight lines. M.G.J.

N68-10520# International Centre for Theoretical Physics, Trieste (Italy).
THREE LECTURES ON TENSOR OPERATORS IN U(n): AN INTRODUCTION TO AN "OPERATOR CALCULUS OF PATTERNS"
L. C. Biedenharn Jul. 1967 37 p refs
(IC/67/52)

The problem of extending the concepts of the Wigner–Racah angular momentum calculus to an arbitrary symmetry group is considered. An attempt is made to develop a canonical resolution of the multiplicity for U(n) for the first nontrivial case U(3). The SU(2) Wigner–Racah calculus is reconsidered, and certain key features are extracted for generalization. The same theme is developed for SU(3), and the general SU(n) problem is discussed in terms of a canonical embedding and the factorization lemma for the boson calculus. Finally, the pattern calculus as it applies to elementary operators is discussed. NSA

N68-10526# Purdue Research Foundation, Lafayette, Ind.
RESEARCH IN NUCLEAR PHYSICS Progress Report
R. M. Steffen 15 Jun. 1967 81 p refs
(Contract AT(11-1)-1420)
(OO-1420-134; PR-17) CFSTI: HC $3.00/MF $0.65

Continuing development of equipment and measurement studies are reported in the following areas: tandem Van de Graaff accelerator installation and beam transport system; nuclear reaction studies with the cyclotron; Coulomb excitation studies of reorientation; angular correlation and internal hyperfine field studies. Theoretical investigations are discussed on the internal conversion coefficients and particle parameters for finite size nuclei, quantum mechanical model of Mössbauer line narrowing, and rotational states of deformed nuclei. N.E.N.

N68-10531# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
CAVITATION NUCLEATION BY ENERGETIC PARTICLES
C. West Jun. 1967 20 p refs
(AERE-R-5486) CFSTI: HC $3.00/MF $0.65

Some recent work on neutron induced cavitation is reported. A brief description is given of the apparatus used to generate a high amplitude ultrasonic field, and of the electronic system. In addition to experiments using an isotope source of neutrons (both slow and fast), some preliminary work with a pulsed D–T generator is described. The problem of nucleation by radiation is discussed and the differences between bubble chambers (where Seitz's theory has been applied with considerable success) and cavitation are outlined. An alternative approach which becomes identical with Seitz's theory for the positive pressure bubble chamber case is considered. Agreement with existing experimental data is improved, but remains quantitatively poor. Author (NSA)

N68-10544# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON ELEMENTARY ACTS WITH TWO QUANTUM JUMPS
Maria Goeppert-Mayer 25 May 1967 24 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 4, no. 3, 1931 p 273–294
(TG-230-T523; TT-63-20480; AD-659184)

Using Diracs theory of dispersion, the probability of the simultaneous emission of two light-quants is calculated. A definite probability is calculated that an excited atom will emit its excitation

energy in two random amounts, if the sum of the energies is constant. If light of frequency less than the excitation frequency is incident on the atom, double emission can still occur. Conversely, the process is considered in which two quanta, the sum of whose frequencies is equal to the excitation frequency, collaborate to excite the atom. Further, the behavior of an atom which can emit light towards colliding particles spontaneously is investigated. Lastly, an attempt is made to clear up anomalies in the spectral line intensities caused by fast-electron collisions on the basis of double processes. Author (TAB)

N68-10552# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ONE-PARTICLE STATES OF DEFORMED NUCLEI OF THE RARE-EARTH REGION IN THE APPROXIMATION OF A FINAL POTENTIAL HAVING A DIFFUSED EDGE [ODNO-CHASTICHNYE SOSTOYANIYA DEFORMIROVANNYKH YADER REDKOZEMEL'NOI OBLASTI V PRIBLIZHENII KONECHNOGO POTENTSIALA S RAZMYTYM KRAEM]

F. A. Gareev, S. P. Ivanova, and B. N. Kalinkin 1967 30 p refs In RUSSIAN. Submitted for publication
(JINR-P4-3451)

An analysis is carried out of one-particle states of deformed axially symmetrical nuclei in the approximation of a final potential having a diffused edge. The schemes of the rare-earth levels, which agree with experiment, are calculated. The consequences of the solution of the problem are discussed. They prove that the use of the states obtained can promote more detailed investigation of the properties of deformed nuclei. Author (NSA)

N68-10571# Stockholm Univ. (Sweden). Inst. of Physics.

HIGH ENERGY NUCLEAR PHYSICS AND ELEMENTARY PARTICLES Final Report, 1 Jan. 1965–30 Jun. 1967

A. G. Ekspong 30 Jun. 1967 100 p refs
(Grant AF-EOAR-64-57)
(AFOSR-67-2294; AD-659490) CFSTI: HC $3.00/MF $0.65

Contents: Strange particle production in 10 GeV/c proton-proton reactions with two observed strange particles; Experimental results on proton-proton interactions at 10 GeV/c producing six charged particles in the final state; Further investigation of the reaction positive-K + p to K + N + pion in all three charge channels at 3 GeV/c; Strange particle production in 10 GeV/c proton-proton reactions with one observed strange particle; Study of pion-nucleon resonances in proton-proton reactions at 19 GeV/c. TAB

N68-10593*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

A PDP-8 INTERFACE FOR A CHARGED-PARTICLE NUCLEAR PHYSICS EXPERIMENT

W. R. Burrus, E. Madden, C. O. McNew, and R. W. Peelle 4 Oct. 1967 33 p refs
(NASA Order R-104(1))
(NASA-CR-88981; ORNL-TM-2013) CSCL 20H

An interface has been constructed to use a PDP-8 computer with a charged particle detector system employing three solid-state detectors and flight-time analysis. Up to 48 bits from each randomly occurring event are transferred through the data (break) channel to a hardware-selected buffer region in the core of a PDP-8 computer. Designed for use as a magnetic tape analyzer for the most complex cases, the system assumes that the 48 bits originate in flag bits set by fast logic and in (presently four) amplitude digitizers, all of which are assumed to contain information for the same event. The system includes some limited capability for controlling the course of the experiment, and provides for readout through the computer of a series of external fast counters. This report summarizes the design concepts, shows schematic flow diagrams, defines the computer instructions associated with the interface system, and gives simple model programs to illustrate application. Author

N68-10595# Oak Ridge National Lab., Tenn.

DOSIMETRY AND SHIELDING IN A 14 MeV NEUTRON GENERATOR

J. Hacke 1967 21 p refs Transl. into ENGLISH from Intern. J. Appl. of Radiation and Isotopes, v. 18, 1967 p 33–44
(ORNL-TR-1757) CFSTI: HC $3.00/MF $0.65

For a 14-MeV neutron generator, which is used mainly for fast neutron experiments, the distribution of flux density and dose equivalent, as well as the effectiveness of shielding, were investigated. Dose equivalent measurements were performed with an Andersson and Braun type dosimeter, which fits the whole energy range $0.025\ eV \leq E \leq 14\ MeV$. Dose equivalent transmission factors of normal concrete were determined in the range of 130 to 160 cm thickness, resulting in a relaxation length of 15 cm. The results of shielding measurements are compared with results obtained from different methods of shielding calculations. In order to compare different neutron dosimeters, some measurements were made in regions with different neutron spectra. Author (NSA)

N68-10599# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics.

MUON CAPTURE NEUTRONS, ASYMMETRY, AND SPECTRUM

Ronald M. Sundelin (Ph.D. Thesis) Jun. 1967 126 p refs
(Contract AT(30-1)-882)
(CAR-882-22) CFSTI: HC $3.00/MF $0.65

The asymmetry in the angular distribution of neutrons emitted following the capture of negative muons in Si, S, and Ca was measured. The measurement was made by stopping polarized muons in a magnetic field, in which the muons precessed, and recording the number of neutrons detected in a fixed counter as a function of the time after a muon stop. The events were simultaneously sorted according to the pulse height observed in the counter. Neutrons were distinguished from gamma rays by pulse shape discrimination. The asymmetries for the three elements, normalized to complete muon polarization, varied from near zero for small pulse heights to $+0.32 \pm 0.05$, $+0.30 \pm 0.08$, and $+0.20 \pm 0.08$ for pulse heights greater than that produced by a 15.6-MeV proton, for Si, S, and Ca respectively. These numbers disagree both in magnitude and in sign with the results of other recent measurements. The neutron energy spectra were obtained from the neutron pulse height spectra by an unfolding process. In the energy range studied, 7.7 to 52.5 MeV, the neutron energy spectra decreased exponentially with increasing energy. The spectral integrals between these energy limits were 0.23 ± 0.04, 0.21 ± 0.04 and 0.18 ± 0.03 neutrons per capture, and the exponential decay constants were 7.6, 7.3, and 7.2 MeV, for Si, S, and Ca, respectively. Author (NSA)

N68-10600# Illinois Univ., Urbana. Dept. of Physics.

REPORT ON THE RECENT BEAM SURVEY OF THE INTERMEDIATE ENERGY MESON BEAM IN THE PROTON AREA AT THE ZGS

W. V. Hassenzahl, C. Mencuccini, E. Beier, R. Edwards, D. Herzo et al Jun. 1967 50 p
(Contract AT(11-1)-1195)
(COO-1195-96; TR-160) CFSTI: HC$3.00/MF$0.65

The primary purpose of the beam survey performed in February, 1967, was to determine the $K^{\pm}$ and $\pi^{\pm}$ fluxes to be expected in future experiments in this beam. The fluxes obtained with a ±1% momentum bite are given. The effect of target thickness on total production is shown. The extrapolation to 0 thickness is used in calculating cross sections. Observed production cross sections are quite similar to those of Novey et al. The $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$ production cross sections from Be, Cu, Ta is used to find the relative production as a function of A. Deviations from the $A^{2/3}$ law are as large as a factor of 1.6. Author (NSA)

N68-10630# International Centre for Theoretical Physics, Trieste (Italy).
MACROSCOPIC CAUSALITY
D. I. Blokhintsev Jun. 1967 55 p refs
(IC-67/36)

The S-matrix is investigated in light of its importance in future developments of the theory of elementary particles. The main properties of the S-matrix are outlined; unitarity, relativistic invariance and causality. The formulation of requirements of causality directly imposed on the S-matrix with recourse to the concept of field is first considered. The possibility of description of a collision process by means of packets localized in space and time is next considered as a necessary precondition for the formulation of macrocausality conditions. The conditions of microcausality are then formulated. NSA

N68-10634# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
CALCULATION OF ELECTROMAGNETIC SHOWERS IN LEAD WITH INITIAL ENERGY OF 6 GEV [RASCHET ELEKTROMAGNITNYKH LIVNEI V SVINTSE S NACHAL'NOI ENERGIEI 6 GEV]
A. A. Varfolomeev and L. B. Drabkin 1966 36 p refs In RUSSIAN
(IAE-1201)

Lateral distributions in electromagnetic cascades are obtained using Monte Carlo methods for the case of an electron primary energy 6 GeV and electron secondary energies greater than 10 MeV with depth ranging from zero to 10 radiation lengths in lead absorber. The following processes were considered: bremsstrahlung, pair production, multiple scattering and ionization loss. In using Bethe–Heitler cross sections the screening effect was taken into account in accordance with the Thomas–Fermi model and correction to Born approximation was introduced. There were 1000 cascades followed with an electron digital computer. Numerical results are presented for electron number distributions of cascades for radial and angular distributions of electrons and positrons, for energy spectrum of electrons and positrons and some additional data on particles not followed in cascades.
Author (NSA)

N68-10635# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TWO-CENTER PROBLEM OF QUANTUM MECHANICS. IV: MATRIX ELEMENTS [ZADACHA DVUKH TSENTROV KVANTOVOI MEKHANIKI. IV: MATRICHNYE ELEMENTY]
L. I. Ponomarev and T. P. Puzynina 1967 47 p refs In RUSSIAN
(JINR-P4-3405)

The results of calculations of some matrix elements by the wave functions of the two-center problem are presented in tables. It is necessary to know them while describing the processes involving three bodies which interact according to the Coulomb Law. Author (NSA)

N68-10636# Oak Ridge National Lab., Tenn.
A STUDY OF THE METHODS FOR ANALYZING MULTILAYER GAMMA-RAY SHIELDS
Iwao Kataoka 1966 196 p refs Transl. into ENGLISH from Senpaku Gijutsu Kenkyujo (Japan), v. 3, no. 4, 1966 p 161–343
(ORNL-TR-1671) CFSTI: HC$3.00/MF$0.65

Two methods are presented for analyzing gamma rays in stratified slab shields. In Part I, a numerical integration method of the Boltzmann transport equation is described, which solves the equation at the discrete points of ordinates of spatial, angular, and energetic. Under the same interval of spatial mesh points, results of test calculations reveal that the method presented gives more correct attenuation of gamma fluxes than, for instance, the discrete S_n method does. A supplemental procedure is provided for a monoenergetic and monodirectional incident source besides the treatments for continuously distributed sources. Part II presents the Response Matrix method as well as a table of the response matrices in the Appendix. The transmission and reflection responses of the gamma rays for an elemental slab of each material were prepared with the Monte Carlo method for the gamma-ray injection of the unit intensity to the slab surface under a certain set of incident angle and energy. The transmitted or reflected gamma rays from a given stratified shield of different materials as well as single material are obtained by operating the response matrices of the elemental slabs composing the shield. The procedures for synthesizing and interpolating the response matrices are given. And the estimated errors accompanied with the procedures were evaluated. In Part III, various results of sample calculations are illustrated. The results computed with the present methods show good agreement with those from the moments method, Monte Carlo calculations, and the experimental measurements. Author (NSA)

N68-10655# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
NEUTRON RADIATIVE CAPTURE BY THE NUCLEI WITH A=140–200 [RADIATSIONNYI ZAKHVAT NEITRONOV YADRAMI S A=140–200]
V. A. Konks, Yu. P. Popov, and Yu. I. Fenin 1967 12 p refs In RUSSIAN Submitted for publication
(JINR-P3-3417)

The results of a measurement of the energy dependence of radiative capture cross sections for neutrons by Eu, ^{153}Eu, Ho, and Lu nuclei in the energy region up to 500 keV are given. The values of the force functions for s- and p-wave neutrons are obtained as a result of the analysis of the energy dependence of averaged capture cross sections. Author (NSA)

N68-10660# Princeton Univ., N. J.
EFFECT OF CROSSING ANGLE ON INTERACTION RATE OF COLLIDING BEAMS
W. C. Barber (Stanford Univ.), G. K. O'Neill, B. Gittelman (SLAC), and B. Richter (SLAC) 12 Sep. 1967 12 p refs Prepared in cooperation with Stanford Univ. and SLAC
(Contract Nonr-1858(39))
(AD-659194) CFSTI: HC$3.00/MF$0.65

A report is given of the results of studies with the Princeton-Stanford storage ring on the beam height at high beam current and on luminosity as a function of crossing angle. TAB

N68-10666 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
THE SECOND NOETHER THEOREM FOR LOCAL FIELD THEORIES
Colber G. Oliveira and Alberto Vidal 1967 41 p refs *Its* Notas de Fisica, V. 13, No. 2

The invariance properties of localized fields under transformation groups involving arbitrary functions are studied from the point of view of the Action Principle. Such invariance is implied in the existence of a set of identities at each space-time point, where the field is defined. These identities can be used as selection rules of the determination of the Lagrangian density of the field. The invariant Lagrangian density for coupled-field is defined in a local affine connected space (the space where the interaction takes place), with a greater number of dimensions than the usual Minkowski space. Also studied were the relations which can be obtained between an infinitesimal gauge group and other infinitesimal discrete groups of invariance, such as the Lorentz group. This is done for the case of electrodynamics. Author

N68-10667# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON THE DECAY OF ^{166}Tm [O RASPADE ^{166}Tm]
A. Abdumalikov, I. Adam, Ya. Vrzal et al 1967 34 p refs In RUSSIAN
(JINR-P6-3343)

Investigations of the ^{166}Tm decay are summarized. Conversion-electron spectra, γ rays, γ–γ and e–γ coincidences were studied. A great number of new γ transitions was found. The multipolarities of a series of γ transitions were determined. The decay scheme constructed was analyzed on the basis of modern nuclear models. Author (NSA)

N68-10699# Ecole Polytechnique, Paris (France). Centre de Physique Theorique.
ON THE "LORENTZ-BASIS" OF THE POINCARE GROUP
Amitabha Chakrabarti, Monique Levy-Nahas, and Roland Seneor May 1967 26 p refs
(NP-16860)

An explicit derivation is given for the matrix elements of the translation generators P_μ of the Poincaré algebra with respect to the "Lorentz-basis," namely in terms of states which diagonalize the two Casimir operators of the homogeneous Lorentz group HLG). The results are given for the cases, mass $\mu > 0$ and $\mu = 0$, and for the latter for discrete and continuous spin. The transforms connecting the momentum and Lorentz bases are discussed, a detailed derivation being given for the zero mass discrete spin case. The matrix elements of $G_\mu = i[(N^2 - M^2).p_\mu)]$ are considered and several interesting aspects of the algebras generated by $\overline{N}$, $\overline{M}$, and $p'_\mu = (\epsilon_1 p_\mu + \epsilon_2 G_{1\mu})$ are discussed for the cases of positive as well as zero rest mass. A discussion of the results obtained is given. Author (NSA)

N68-10702*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
EXPERIMENTAL ELECTRON SHIELDING STUDIES
Technical Summary Report
C. Jupiter and G. Merkel 26 Nov. 1965 73 p
(Contract NAS8-11304)
(NASA-CR-89966; GACD-6844) CFSTI: HC $3.00/MF $0.65
CSCL 18F

The experimental apparatus for measuring the electron penetration through thick slabs and for measuring the production of bremsstrahlung in thick slabs has been designed and assembled. The energy and angular spectra of electrons produced by the passage of 8.2 and 4.0 MeV electrons through various thick aluminum targets have been measured and compared to Monte Carlo calculations. A number of bremsstrahlung spectra measurements at 8.0 and 4.0 MeV have also been obtained. The design of a scattering chamber which will be the principal component in an experimental system to measure electron single interaction cross sections and single interaction bremsstrahlung production in thin targets has been completed. The present experimental setup allowed measurements using thick targets for electron and bremsstrahlung spectrum measurements for emission angles between 0 and 45 degrees. The new scattering chamber will allow an extension of these measurements to both thick and thin target electron and bremsstrahlung spectra for emission angles between 0 and 165 degrees. Author

N68-10731 Technische Hochschule Hannover (West Germany).
DETERMINATION OF THE CHARACTERISTIC VALUES FOR THE DIFFUSION OF FAST NEUTRONS IN CONCRETE BY MEASURING THE SCATTERING CROSS SECTION OF A COLLIMATED NEUTRON BEAM [BESTIMMUNG DER KENNGROESSEN FUER DIE AUSBREITUNG SCHNELLER NEUTRONEN IN BETON DURCH AUSMESSUNG DES STREUFELDES EINES KOLLIMIERTEN NEUTRONEN-STRAHLES]
Hilmar Bindewald (Ph.D. Thesis) [1966] 59 p refs In GERMAN

Measured was the neutron field produced by a collimated beam of fast neutrons in concrete. The solution of monoenergetic Boltzmann transport equation is used in connection with two appropriate parameters to derive a formula for describing the measured neutron field. The two parameters serve to determine length of transport path, length of diffusion, and other material constants for neutron transport in concrete. Transl. by K.W.

N68-10738# Lyon Univ. (France). Inst. of Nuclear Physics.
STUDY OF A DIFFRACTION MODEL FOR ELASTIC SCATTERING OF PARTICLES OF MEDIUM ENERGIES [ETUDE D'UN MODELE DIFFRACTIONNEL POUR LA DIFFUSION ELASTIQUE DE PARTICULES DE MOYENNES ENERGIES]
Jacques Meyer (Ph.D. Thesis) May 1967 110 p refs In FRENCH
(LYCEN-6729)

The phenomenon of diffraction as it is presented in classical optics is reviewed in order to derive the principal hypothesis which, transposed to nuclear physics, constitutes the basis of diffraction models. Two of these models are then analyzed in order to define certain approximations which, if they are justified from the mathematical viewpoint, have removed from the model a little of its physical reality. The necessary hypotheses are then restudied in order to construct a diffraction model that is closer to the physical mechanism. This model was tested on the elastic scattering ^{208}Pb(n,n)^{208}Pb at 14.5 MeV in order to test the validity of the expressions. NSA

N68-10751# Joint Inst. for Nuclear Research, Dubna (USSR).
STRAY RADIATION AT ACCELERATOR HALLS [RASSEY-ANNOE IZLUCHENIE V POMESHCHENIYAKH USKORITELEI]
L. R. Kimel, M. M. Komochkov, V. P. Sidorin, B. S. Sychev, and E. P. Cherevatenko 1967 24 p refs In RUSSIAN
(JINR-P9-3402)

The problems of stray radiation at accelerator halls were considered. Approximate formulas for calculation of stray radiation fluxes of different energy groups are obtained. The method suggested is applied for calculations of stray radiation fields at the JINR synchrocyclotron hall. Author (NSA)

N68-10752# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

SYNCHROTRON RADIATION OF RELATIVISTIC CHARGES IN A METAL TUBE [SINKHROTRONNOE IZLUCHENIE RELYATIVISTSKIKH ZARYADOV V METALLICHESKOI TRUBE]

A. G. Bonch-Osmolovskii and K. A. Reshetnikova 1967 15 p refs In RUSSIAN Submitted for publication
(JINR-P9-3415-2)

The problem is solved of the radiation of charges having a spiral path in a magnetic field inside a hollow round metal tube. An expression is obtained, in a general form, for the radiation intensity of an azimuthal-inhomogeneous thin charged ring. It is shown, in particular, that the charges do not radiate at all when their radius of rotation is rather similar to that of the tube. Author (NSA)

N68-10757# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Chemistry.

NUCLEAR CHEMISTRY RESEARCH OF HIGH ENERGY NUCLEAR REACTIONS AT CARNEGIE INSTITUTE OF TECHNOLOGY Annual Progress Report, 1966–1967

1 Jun. 1967 70 p refs
(Contract AT(30-1)-2897)
(NYO-2897-22) CFSTI: HC $3.00/MF $0.65

Nuclear research activities centered on the following topics: (1) *Magnesium*^{25}—proton cross sections and recoil reactions; (2) *Magnesium*^{26}—cross sections for proton reactions; (3) *Aluminum*^{27}—cross sections for proton reactions up to 400 MeV; (4) *Cadmium Isotopes*—proton reactions at 400 MeV; (5) *Antimony*$^{129, 127, 125, 122,}$ *and Iodine*^{122}—beta decay half life; (6)*Antimony*^{124} *and Tellurium*^{129,127}—isomeric halflife beta decay; (7) *Tellurium*^{121} *and Iodine*^{125}—halflife decay and electron capture; (8) *Tellurium*$^{125, 123, 121}$—isomeric electromagnetic decay half-life; (9) *Iodine*$^{124, 121}$—beta and electron-capture half-life; (10) *Copper*^{65}—recoil studies of proton reactions; (11) *Protons*—reaction cross sections for copper^{63} and iron^{56} at 100 to 400 MeV; (12) *Tetraneutrons*—construction of experimental equipment, and (13) *Computer Programs*—program reviews for nuclear reaction studies. G.G.

N68-10760# Oregon State Univ., Corvallis. Dept. of Physics.

[NUCLEAR PHYSICS] Progress Report, Period Ending Jul. 31, 1967

31 Jul. 1967 56 p refs
(Contract AT(45-1)-1062)
(RLO-1062-675) CFSTI: HC $3.00/MF $0.65

Theoretical and physical work on nuclear reactions covered energy level transitions and decay spectra of various metal isotopes, particle scattering analyses and theories, and the development of vacuum systems, ion production sources, and cyclotrons. G.G.

N68-10786# Los Alamos Scientific Lab., N. Mex.

DELAYED NEUTRONS IN THE FISSION OF ^{232}Th, ^{235}U, AND ^{238}U

B. P. Maksyutenko [1966] 11 p refs Transl. into ENGLISH from Byull. Inform. Tseentra Yadern. Dannym (USSR), no. 3 [1966], p 75–84
(LA-TR-67-16) CFSTI: HC $3.00/MF $0.65

The effect of the (n,nf) reaction on the yield ratios of delayed neutron groups from the fission of ^{232}Th, ^{235}U, and ^{238}U at neutron energies of 5 to 7.75 MeV was investigated. The analysis of the decay curves was made using a digital computer with fixed values of the decay constants. NSA

N68-10788# Oak Ridge National Lab., Tenn.

SHOWERS IN LEAD PRODUCED BY 0.1 TO 1 GeV γ-QUANTA [LIVNI V SVINTSE OBRAZOVANNYE γ-KVANTAMI S ENERGIEI OT 0.1 DO 1 GeV]

O. A. Zaimidoroga, Yu. D. Prokoshkin, and V. M. Tsupko-Sitnikov 1966 12 p refs Transl. into ENGLISH from Russian Submitted for publication
(ORNL-TR-1672; JINR-P1-2990)

The characteristics of the showers, produced in lead by γ-quanta with the energy 0.1; 0.2; 0.3; 0.5, and 1 GeV, are determined on the basis of the experimental data on distributions according to the electron number in showers, generated by electrons in lead. Author (NSA)

N68-10793# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

EXCITATION FUNCTIONS AND ANGULAR DISTRIBUTIONS OF MULTINUCLEON TRANSFER REACTIONS IN THE INTERACTION BETWEEN COMPLEX NUCLEI [FUNKCJE WZBUDZENIA I ROZKLADY KATOWE REAKCJI PRZEJSCIA WIELU NUKLEONOW W ODDZIALYWANIU Z CIEZKIMI JONAMI]

Jan Tys 1967 6 p refs In POLISH
(INR-791/IA/PL)

Excitation functions of 3p and 2p2n transfer reactions and p or 2n exchange reactions were measured with C, Al, Cu and Ta targets bombarded with ^{16}O, ^{20}Ne, and ^{22}Ne ions in the energy interval of 5 to 8 MeV/amu. Angular distributions of ^{17}N nuclei in the 3n transfer reactions on Ta and Au and 2n transfer reactions on Ta, Au and ^{90}Zr, ^{92}Zr, ^{94}Zr, bombarded with ^{14}N and ^{15}N ions about 90 MeV and 100 MeV were measured. Author (NSA)

N68-10794# Stanford Univ., Calif. Linear Accelerator Center.

THROBBING BEAM TRANSVERSE RESISTIVE INSTABILITIES IN CIRCULAR ACCELERATORS AND STORAGE RINGS

M. J. Lee, F. E. Mills (Wis. Univ.), and P. L. Morton Aug. 1967 68 p refs
(Contract AT(04-3)-515)
(SLAC-76) CFSTI: HC $3.00/MF $0.65

A study was conducted of the cross-sectional oscillations of a nearly circular beam centered in a circular pipe, and a self-consistent solution was obtained for both monopole and multipole oscillations. Dispersion relations for the oscillation frequencies were found, and conditions for stability were deduced. For multipole instabilities the growth rates and thresholds are close to those obtained for the dipole instability, differing only by a geometrical factor; whereas, for the monopole instability, the growth rates are so small that the oscillations in present accelerators and storage rings will be suppressed by the physical processes such as interaction with the residual gas, radiation damping, etc. In all cases, the growth rate is proportional to the number of particles in the beam and inversely proportional to the square root of the wall conductivity. It is shown that in the absence of Landau damping a longitudinally continuous beam is always unstable against the development of transverse waves having a phase velocity close to $(n-m\nu_0)\,\Omega R$, where ν_0 is the number of betatron oscillations per revolution, Ω is the revolution frequency, R is the radius of the machine, n is an integer greater than $m\nu_0$ with 2m the multipole number (m=1 for dipole and m=2 for quadrupole, etc.). A condition for stable

multipole oscillations for a single bunched beam is found to be $n<\nu_0<[n+(1/2m)]$. It is known that unstable oscillations can be Landau damped by having a sufficiently large spread in the betatron oscillation frequency $\nu_0\Omega$. ω. A criterion for the spread required to damp unstable quadrupole oscillations of a bunched beam is shown to be, in the limit of low energy, dependent upon the particle density, energy and the betatron oscillation frequency, but not upon the conductivity. For the case of equal horizontal and vertical betatron frequencies monopole and multipole oscillations can exist independently. However, for the case of a large difference between the two frequencies, it is found that coupling exists between monopole and quadrupole oscillations, and the motion of the beam is characterized by two normal modes such that the monopole and quadrupole oscillations are in phase in one mode and 180° out of phase in the other. Author (NSA)

N68-10811# European Nuclear Energy Agency, Ispra (Italy). Computer Programme Library.
KWIC INDEX OF NUCLEAR PROGRAMMES
Jun. 1967 135 p refs
(NP-16975)

A brief description is given, in KWIC form, of all the programs which are now in the ENEA library and of some programs of general interest which have been offered to the library. Reference materials is included with each KWIC entry. NSA

N68-10816# California Univ., Livermore. Lawrence Radiation Lab.
MEASUREMENT OF FLUX DENSITY AND DOSE RATE REMOVAL CROSS SECTIONS OF VARIOUS SHIELDING MATERIALS FOR NEUTRONS [MESSUNG VON FLUSSDICHTE- UND DOSISLEISTUNGS-BESEITIGUNGS-QUERSCHNITTEN VERSCHIEDENER ABSCHIRMMATERIALIEN FUER NEUTRONEN]
D. Nachtigall and M. Heinzelmann Dec. 1966 21 p refs Transl. into ENGLISH from German
(UCRL-TRANS-10128; JUL-435-ST)

The attenuation of neutrons is investigated for different materials. The removal cross sections and the buildup factors for the neutron flux density and the dose rate equivalent for neutron energies from 0.03 to 4.5 MeV were measured. Flux density and dose-rate equivalent are measured independently from thermal neutron energy to the maximum energy. Measurements are made with radioactive neutron sources and at the reactor. The results of the long counter and of the dosimeter of Andersson and Braun were compared with the results of a scintillation counter with five different polyethylene spheres. Author (NSA)

N68-10835# Ecole Polytechnique, Paris (France). Centre de Physique Theorique.
POLARIZATION OF RESONANCES IN A SIMPLE PERIPHERAL SU(6)W-MODEL
Manuel G. Doncel [1967] 9 p refs
(NP-16936)

A simple generalization of the peripheral $SU(6)_w$-invariant model, which can also be applied to interactions of the type P+N→V+N and P+N→V+D, is sketched. The polarization of the resonances in these interactions is predicted without any arbitrary parameters. Some of these predictions are compared with experimental data, and an acceptable agreement is found. Experimental results on the spin and isospin character of the exchanged particle are explained. Some failures of exact $SU(6)_w$ symmetry are understood and disappear in the model. NSA

N68-10836# Oak Ridge National Lab., Tenn.
MEASUREMENTS OF DOSE BUILDUP FACTORS IN SLAB MATERIALS FOR AN ISOTROPIC Co-60 SOURCE
Kanemori Yoshihiko Jun. 1966 11 p Transl. into ENGLISH from Nippow Genshiryoku Gakkaishi (Japan), v. 8, Jun. 1966 p 304–308
(ORNL-TR-1649) CFSTI: HC $3.00/MF $0.65

Gamma ray transmission dose rates were measured for the case where the line connecting a ^{60}Co point isotropic source and the detector center lies obliquely against the absorber plane, to derive the relation between dose buildup factors and the oblique angles between the connecting lines and the absorber plane. The slab materials taken up were aluminum, iron, and lead. In addition, transmission dose rates for a line isotropic source were obtained by numerical integration of the measured dose rates for point sources, sources, and relations similar to the case of point source were derived between dose buildup factors and oblique angles. Dose buildup factors for a plane isotropic source were also determined. Author (NSA)

N68-10837# California Univ., Berkeley. Lawrence Radiation Lab.
MODEL FOR THE DECAY $\Sigma(1660)\rightarrow\Sigma\pi\pi$
Philippe Eberhard and Morris Pripstein 17 Jul. 1967 10 p refs
(Contract W-7405-ENG-48)
(UCRL-17682) CFSTI: HC $3.00/MF $0.65

An explicit calculation of the probability distributions of the particles $\Sigma\pi\pi$ from $\Sigma(1660)$ decay was performed. The model for the decay process is described and the result of the computation is given. Author (NSA)

N68-10839 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
SUPERCONVERGENCE AND BOOTSTRAP IN STATIC MODELS
B. Diu Sep. 1967 40 p refs
(TH/217)

A comparison between saturated superconvergence sum rules and bootstrap relations is carried out in static models. After a discussion on the possible meaning of superconvergence in such models, the analogy found in the πN case is shown to hold in more general situations. A number of important differences are however brought out by a more detailed investigation. In particular, the validity of the saturation approximation is seriously questioned: whether the relations it gives are satisfied seems to be independent, in these static models, of the convergence of the amplitudes. Author

N68-10840# Oak Ridge National Lab., Tenn.
EQUIVALENT THICKNESSES OF MATERIALS FOR THE ATTENTUATION OF GAMMA-RADIATION
Arnost Hoenig [1967] 7 p refs Transl. into ENGLISH from Jaderna Energie (Czechoslovakia), v. 12, 1966 p 296–298
(ORNL-TR-1666)

Tables are included of thicknesses of various materials as heavy and ordinary as concrete, aluminum, water, and steel, for gamma radiation attenuation equivalent to lead thickness in the dependence of photon energy. Author (NSA)

N68-10876# California Univ., Berkeley. Lawrence Radiation Lab.
LECTURES, INELASTIC SCATTERING AND NUCLEAR STRUCTURE
Norman K. Glendenning [1967] 83 p refs Presented at the Intern. School of Phys., "Enrico Fermi", Course 40, Varenna (Como), Italy, 26 Jun.–15 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-17503) CFSTI: HC $3.00/MF $0.65

The theory of inelastic scattering and its applications to the study of the properties of individual nuclear states are reviewed. NSA

N68-10878# Brookhaven National Lab., Upton, N. Y.
MODERN NUCLEAR FORCE MODELS [SOVREMENNYE MODELI YADERNYKH SIL]
V. V. Babikov 1967 12 p refs Prsented at the 17th Conf. on Nucl. Spectry. and the Struct. of Atomic Nucleus, Khar'kov, 1967
(BNL-TR-140; JINR-P4-3136)

Different models of nucleon–nucleon interaction, used in nuclear physics, are discussed. Author (NSA)

N68-10880 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
ALGEBRA OF CURRENT AND $\rho\pm \rightarrow \eta + \pi\pm$ DECAY
Prem P. Srivastava 1967 8 p refs *Its* Notas de Fisica Vol. XIII, No. 1

The G-parity violating decay mode $\rho \rightarrow \eta\pi\pm$ using current algebra of scalar densities is studied and related it to the dominant decay mode $\rho \rightarrow 2\pi$ governed by strong interactions. The decay under consideration may provide an independent test of the hypothesis involved in the current algebra approach. Author

N68-10898# Oak Ridge National Lab., Tenn.
COMPUTER PROGRAM JUPITOR-1 FOR COUPLED-CHANNEL CALCULATIONS
Taro Tamuro Aug. 1967 135 p refs
(Contract W-7405-ENG-26)
(ORNL-4152) CFSTI: HC $3.00/MF $0.65

The FORTRAN listing and the corresponding description of a computer program named JUPITOR-1 (abbreviated JP1) is presented. This program can be used to perform coupled-channel calculations to evaluate the cross sections for the scattering of nuclear particles by nuclei. Preparations of the input data cards are explained in great detail with illustrations. Ways of possible modification or expansion of the present program are also suggested. Author (NSA)

N68-10901# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
QUARK MODEL PREDICTIONS FOR HADRON DECAYS. II: ELECTROMAGNETIC DECAYS
A. Dar 14 Aug. 1967 22 p refs Presented at the 3d Intern. Symp. on Electron and Photon Interactions at High Energies, Stanford, Calif., 5–9 Sep. 1967
(Contract AT(30-1)-2098)
(MIT-2098-359; CONF-670923-1) CFSTI: HC $3.00/MF $0.65

The predictions of two quark model for the electromagnetic decay model of the fundamental pseudoscalar and vector meson nonets and of the fundamental baryon octet and decuplet are compared. The electromagnetic vertices considered are of two types: In the first type a quark reverses its spin direction and emits a photon. In the second type a quark–antiquark pair annihilates into a photon. NSA

N68-10905*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
A FEASIBLE SATELLITE EXPERIMENT FOR GAS MOLECULE-SOLID SURFACE INTERACTION STUDIES Final Report
Jens C. Zorn and John C. Pearl Oct. 1967 123 p refs
(Contract NAS8-21096)
(NASA-CR-90101; Rept.-08700-1-F) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The main objective of the proposed experiment is to explore the interactions of nitrogen molecules with engineering and scientific surfaces as they occur in an earth satellite environment. The present report is mainly concerned with measuring techniques for molecular nitrogen. Features of a proposed configuration and of a metastable time-of-flight analyzer, the fluxes of N_2, O_2, and O expected along the spacecraft's orbit, and the interpretation of a time-of-flight spectrum in terms of a molecular velocity distribution function are given. The collision-induced modifications of the velocity distribution of a collimated molecular beam were measured, and the findings of this experiment were evaluated for the proposed gas–surface interaction studies. Stability and operational reliability of the metastable detector under adverse conditions is discussed. Also described are experimental studies of novel methods for preparing clean target surfaces in orbit. K.W.

N68-10915 Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente.
DETERMINATION OF THE FLUX OF THERMAL NEUTRONS USING COBALT SONDES [DIE BESTIMMUNG DER FLUENZ THERMISCHER NEUTRONEN MIT HILFE VON KOBALTSONDEN]
L. Weise Jul. 1967 41 p refs In GERMAN
(JUL-495-RX) CFSTI: $3.00

Activated cobalt detectors are recommended for thermal neutron flux measurements. The nuclear reaction Co^{59} (n,γ) Co^{60} and its neutron capture is used to measure thermal neutron flux and to develop the physical aspects of the problem. A description of different detector geometries and their error effects on obtained results is included. Transl. by G.G.

N68-10930 Centro Brasileiro de Pesquisas Fisicas, Rio De Janeiro.
OBSERVATION OF EXTREMELY HIGH ENERGY NUCLEAR INTERACTIONS WITH EMULSION CHAMBER
M. Akashi, Z. Watanabe (Hirosaki Univ.), K. Nishikawa, Y. Oyama, S. Hazama (Konan Univ.) et al 12 Jul. 1967 47 p *Its* Notas de Fisica V. 13, No. 4

The present report covers experimental results obtained from the emulsion chambers exposed on Mt. Chacaltaya (5,200 m) Bolivia, and Mt. Norikura (2,800 m) Japan. Table A presents a list of the exposures made up to the present. Author

N68-10933# Brookhaven National Lab., Upton, N. Y.
REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP
H. T. Motz, comp. Apr. 1967 153 p refs Presented at AEC Nucl. Cross Sect. Advisory Group Meeting, European-Am. Nucl. Data Comm., Brookhaven, N. Y., 13–14 Apr. 1967
(Contract W-7405-ENG-36)
(WASH-1074; EANDC(US)-99U; INDC(US)-9U) CFSTI: HC $3.00/MF $0.65

Cross section data, in the form of tabulations and graphs, are presented on chromium, samarium, platinum, erbium, carbon, hafnium, thulium, uranium, holmium, tungsten, oxygen, calcium, bismuth, silicon, rhenium, zirconium, scandium, neptunium, americium, sodium, deuterium, lithium, thorium, strontium, boron, calcium, fluorine, lead, magnesium, sulfur, rhodium, zirconium hydrides, niobium hydrides, uranium oxides, ethylene polymers, aluminum, iron, nickel, helium, nitrogen, yttrium, and zirconium. Fission fragment range–energy relationships are determined for gases, and nuclear reactions are considered in terms of the theory of elastic scattering and the theory of giant dipole resonances. M.G.J.

N68-10934* California Univ., Los Angeles. Dept. of Engineering.
PERFORMANCE OF AN ARC-HEATED SUPERSONIC MOLECULAR BEAM AND ITS APPLICATION TO MOLECULE–MOLECULE COLLISION STUDIES
Neil Marshall Kuluva (Ph. D. Thesis) Apr. 1967 127 p refs
(Grants NsG-237-62; NSF GP-534; NSF GK-580)
(NASA-CR-89318; Rept.-67-11) CSCL 20H

The molecular beam density, energy, and velocity of the arc-heated, supersonic, argon molecular beam system were studied experimentally. In the tests, a flow-through ionization detector was used to monitor the beam density, with a single-disk chopper or a two-disk velocity filter used to modulate the beam. A photocell apparatus, focused on either of the velocity filter disks or on the beam chopper disk, provided the triggering signal for beam detection. The parameters varied during the experiments included the plasma head power input, plasma unit electrode configurations, stagnation chamber pressure, argon mass flow, distance from the nozzle to the skimmer, nozzle diameter, skimmer diameter, source chamber pressure, and collimating chamber pressure. Measured beam energies ranged as high as 2.7 ev; argon–argon integral collision cross sections were measured using angular resolutions as small as 2.2'. It was concluded that the applicability of the arc-heated supersonic molecular beam to collision cross section measurement in the 1 to 10 ev energy range was demonstrated. M.G.J.

N68-10944# Office of Naval Intelligence, Washington, D. C.
VENTILATION IN WORK WITH RADIOACTIVE SUBSTANCES
V. M. Krupchatnikov 7 Aug. 1967 252 p refs Transl. into ENGLISH of the book "Ventilyatsiya pri Rabotakh s Radioaktivnymi Veshchestvami" Moscow, Council of Min. Publishing House, 1964 250 p
(NOO-Trans-2432; TT-67-62982; AD-659190)

Contents: Brief information on radioactive matter and on its effect on the human organism; The basic points with respect to the arrangement of internal systems of ventilation; The design and calculation of filters for the purification of ventilation discharges; Chimneys for the discharge of ventilated air; Centralized systems of intake-exhaust ventilation. TAB

N68-10950# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ALGEBRA OF CURRENT AND THE DEVIATION FROM 1/2 RULE IN KAON–3 PION DECAY
C. Bouchiat and Ph. Meyer Jul. 1967 8 p refs
(LPTHE-TH-207)

Starting from the usual current–current weak Lagrangian and using current algebra, the deviations from the $|\Delta I| = 1/2$ rule in $K \to 3\pi$ decays are determined in terms of the $K \to 2\pi$ rates. The need for better data on $K \to 2\pi$ and $K \to 3\pi$ decays is stressed in order to arrive at a possible discrimination between a fundamental or a dynamic $|\Delta I| = 1/2$ rule. As a by-product the PC conserving 3π decay of K_1^0 is calculated in the linear approximation. Author (NSA)

N68-10972# Los Alamos Scientific Lab., N. Mex.
STATUS REPORT ON OPACITY CALCULATIONS, SUPPLEMENT II
Walter F. Huebner, John Generosa (AF Weapons Lab., Kirtland AFB, N. Mex.), and Richard Harris (AF Weapons Lab., Kirtland AFB, N. Mex.) 16 Aug. 1967 66 p refs
(Contract W-7405-ENG 36)
(LA-3002-MS, Suppl. 2) CFSTI: HC $3.00/MF $0.65

The results of a survey in the opacity field have been compiled and are presented here categorized according to the various phases of an opacity calculation. The categories include: energy levels, wave functions, electronic occupation, bound–free transitions, free–free transitions, bound–bound transitions, scattering, molecular transitions and complete opacity calculations. A list of scientists recently active in one or more of these fields is included. Author (NSA)

N68-10997 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
RESEARCH ON THE EMISSION OF ELECTRONS FROM SURFACES BOMBARDED WITH IONS OF NOBLE GASES [STUDIO DELLA EMISSIONE DI ELETTRONI DA SUPERFICI BOMBARDATE DA IONI DI GAS NOBILI]
F. Catoni and G. Cipolloni 1967 25 p refs In ITALIAN
(RT/EL(67)8)

Slight emission of electrons was recorded for polished samples of noble gases bombarded with ions in a limited energy range. There is little evidence to support extending the energy range of measurements or to simplify the measurement techniques to permit determination of secondary electron emission. Transl. by M.W.R.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-10014# California Univ., Berkeley. Lawrence Radiation Lab.
PROPAGATION CHARACTERISTICS OF A HOLLOW PLASMA WAVEGUIDE
Joseph E. Katz May 1967 58 p refs
(W-7405-ENG-48)
(UCRL-17564) CFSTI: HC $3.00/MF $0.65

The dispersion relation for the axial propagation of electromagnetic energy in a hollow plasma waveguide is derived. The structure considered has a cross section consisting of a central cylindrical vacuum region surrounded by a plasma shell contained within a metal outer conductor. Solutions of the dispersion relation are presented which show the variation in propagation characteristics attained by varying the plasma properties, the radial dimensions, or the external magnetic field. Losses in the plasma region and the effect of finite conductivity in the metal outer conductor are considered. Propagation characteristics of a hollow plasma waveguide resemble those of a metal circular waveguide for large axial magnetic fields, but as the axial magnetic field is reduced, the phase characteristic of the guide changes to that of a slow wave structure. The attenuation characteristic of the hollow

plasma waveguide, for waves of a TM type, may be lower by several powers of ten than that of conventional metal waveguides. Author (NSA)

N68-10073# Pennsylvania State Univ., University Park. Ionosphere Research Lab.

LONGITUDINAL WAVES IN A PLASMA HALF SPACE

W. M. Black 10 Oct. 1967 74 p refs

(Grant NsG-134-61)

(NASA-CR-90045; SR-311) CSCL 20I

The electric field in a plasma half space is determined using a normal mode analysis with collisions considered using a BGK particle conserving collision model. For the collisionless case, the results are shown to be equivalent to the results of Landau, who used transform methods. For distances greater than five Debye lengths from the boundary, and for collision frequencies up to $.01\omega_p$ it is shown that collisions have little effect on the electric field except in the frequency range $.95\omega_p<\omega<1.2\omega_p$. Within this frequency band, collisions produce different kinds of effects, depending upon the frequency of the applied field and upon the collision frequency. For most of the frequencies, the field is damped more rapidly with distance. For special frequencies, however, collisions destroy the collisionless damping and reduce the total damping. Author

N68-10288# Stanford Univ., Calif. Inst. for Plasma Research.

STUDIES OF BEAM–PLASMA INTERACTION WITH TRANSVERSE MODULATION

D. M. Mills, E. E. Abraham, and F. W. Crawford Mar. 1967 41 p ref

(Contract AT(04-3)-326)

(SU-IPR-141) CFSTI: HC $3.00/MF $0.65

Experimental observations are described of electron beam/plasma interaction in low-pressure mercury-vapor discharges. Comprehensive data have been obtained of rf growth, phase velocity, axial and radial electric field profiles in the interaction region, and Faraday rotation, for the case of transverse modulation, i.e., for growth in the first azimuthally varying mode (m=1). The work complements previous parallel studies of the axisymmetric mode (m=0) made with axial modulation. The results are compared with cold and warm plasma theories of the interaction. It is concluded that the warm plasma theory gives a satisfactory approximation to the experimental results, and that the remaining discrepancies are due to lack of sharpness of the experimental beam edge. Author (NSA)

N68-10398*# Avco-Everett Research Lab., Everett, Mass.

[AVCO EVERETT RESEARCH LABORATORY QUARTERLY PROGRESS REPORT, 24 JUNE–23 SEPTEMBER 1967]

Oct. 1967 20 p refs

(Contract NAS8-20310)

(NASA-CR-89956) CSCL 20I

Limits that constrain charge injections were studied in a toroidal experiment, and an analog tank was developed for possible use in evaluating the effects of differential geometrical arrangements for the plasma radiation shields and estimating the weights of full-scale shielding systems. An analytical demonstration was made of the existence of holes in electron clouds associated with the solenoid configuration, although the method used has limited practical value for the design of plasma radiation shielding. An apparatus for a planned high vacuum experiment is shown; and it is expected that this experiment will counteract the limited voltage, gain, and containment time in the present torus experiment. M.W.R.

N68-10493# Massachusetts Inst. of Tech., Cambridge.

MAGNETOGASDYNAMICS OF CHEMICALLY REACTING SYSTEMS Final Report

T. Y. Toong 2 Oct. 1967 12 p refs

(Grants DA-ARO(D)-31-124-G190; DA-ARO(D)-31-124-G593)

(Rept.-3149.8-E; AD-659406) CFSTI: HC $3.00/MF $0.65

A summary is given of the progress and results of a research program involving studies of magnetogasdynamic effects in problems where chemical reaction plays an important role. Topics include: Propagation, structure, and stability of laminar flames; propagation and structure of detonation waves; flows behind detonations; ionization in shocks and detonations. A list of publications resulting from the work is included. TAB

N68-10519* Stanford Research Inst., Menlo Park, Calif.

DEVELOPMENT OF A TOROID HAVING UNIQUE PARTIAL-SWITCHING CHARACTERISTICS AND FABRICATION OF AN INTEGRATED MAGNETIC LOGIC STRUCTURE Final Report

C. H. Heckler, Jr. Oct. 1967 133 p

(Contract NAS1-5963)

(NASA-CR-66496) CFSTI: $3.00 CSCL 20I

An earlier survey of a group of memory cores showed a variability in their partial-set-state threshold characteristics which suggested that they could be obtained by some other method. The purposes of the present project were (1) to investigate the characteristics of several ferrite materials and the factors controlling them, with a view to finding a material and a process yielding cores with specified partial-set-state threshold characteristics; (2) to determine if this could be done in a small-size core; and (3) to investigate the feasibility of achieving an integrated magnetic circuit element to minimize the complexity of associated wiring and reduce the size. This last objective was to be pursued by utilizing the materials and the knowledge gained in the investigation of the control of magnetic characteristics, to make a more complex (functionally and geometrically) ferrite structure. The goal was to make a single structure that would functionally replace a circuit containing 80 toroidal cores. Author

N68-10550# Illinois Univ., Urbana. Dept. of Electrical Engineering.

RESEARCH STUDIES OF HIGH-DENSITY PLASMAS Final Report, 15 Sep. 1964–15 Jan. 1967

E. Bialecke, E. Vesely, L. Dreyer, T. Dolan, and M. Merkelo Jun. 1967 130 p refs

(Contract DA-28-043-AMC-00094(E))

(ECOM-00094-F; AD-659416)

A review of the experimental studies of high-density plasmas made under this contract is given and the application of a high-density plasma in a high-current switch is analyzed. The diagnostic methods using microwave probing, photographic methods, gross light emission from the plasma, spectral radiation from the high-density plasma, magnetic probing, laser interferometers, scattering of laser radiation, and direct measurement of the resistance of the high-density plasma are described and the significant results detailed. The electron density, electron temperature, current flow and motion and size of the plasma determined by these methods are given with both spatial and temporal resolution. TAB

N68-10553# Sydney Univ. (Australia). Wills Plasma Physics Dept.

PROPAGATION OF HYDROMAGNETIC IONIZING FRONTS WITH LARGE DRIVING CURRENTS

R. C. Cross, B. W. James, and C. N. Watson-Munro Apr. 1967 4 p refs

(NP-16892; ER-25)

The production of highly ionized dense plasmas with hydromagnetic ionizing waves was investigated using the SUPER II machine. The steady axial magnetic field covered values up to 12 kG and the azimuthal drive magnetic field covered values up to 3 kG. NSA

N68-10592# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. (Calif. Univ., Berkeley) 30 Sep. 1967 22 p refs *Its* No. 24
CFSTI: HC$3.00/MF$0.65

This bibliography contains 91 titles on the spectroscopy of interest to high temperature chemistry, and 109 titles on the reactions between gases and condensed phase. The works were chiefly published in 1966 and 1967. K.W.

N68-10604# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF THE INVESTIGATION OF ELEMENTARY PROCESSES IN LOW-TEMPERATURE PLASMA
V. N. Kondrat'yev, Ye. Ye. Nititin, and V. L. Tal'roze 18 Aug. 1967 39 p refs Transl. into ENGLISH from the Russian
(FTD-MT-65-525; AD-659313)

The present status of the theories and experimental data on elementary processes in low-temperature plasma is considered. Particular attention is paid to: (1) Thermal dissociation of diatomic molecules; (2) Thermal dissociation of polyatomic molecules; (3) Exchange reactions; (4) Excitation and ionization of atoms by electrons; (5) Impact ionization; (6) Recombinative ionization; (7) Electronic excitation, electronic energy transfer and charge transfer in atomic and molecular collisions; (8) Ion-molecular reactions; (9) Dissociative recombination; (10) Associative ionization. The insufficient accuracy of present rate constant determinations is emphasized and the necessity in extensive theoretical investigations of above problems is discussed. Author (TAB)

N68-10613 Lockheed Missiles and Space Co., Palo Alto, Calif.
COMPARISON OF MICROWAVE METHODS OF PLASMA INVESTIGATION
L. A. Dushin, V. G. Grigorenko, A. I. Skibenko, and I. L. Fomin [1967] 11 p refs Transl. into ENGLISH from the book "High Frequency Properties of Plasma" Kiev, Nauk. Dumka Press, 1967 p 95–107

Radial density distribution measurements by different microwave methods, and by using a double electric probe, were performed on a plasma in a strong magnetic field under conditions when the size of the probing beam is commensurate with the size of the plasma inhomogeneities or is much smaller. Microwave methods used were (1) microwave refraction, (2) reflected wave phases, and (3) damping of microwave signals. Measurements using the probe were performed in the ion current saturation mode. Results obtained by the various means were compared, and evaluated. L.S.

N68-10649 Institut für Plasmaphysik G.m.b.H. Garching (West Germany).
ON DIFFUSION IN THE GARCHING OCTOPOLE DEVICE
H. Grawe Oct. 1967 33 p refs Supported in part by EURATOM
(IPP-6/61) CFSTI: $3.00

Previous papers on the octopole experiments treated the various loss mechanisms in the octopole device as independent of each other. In addition to diffusion across the magnetic field the loss flux along $\underline{B}$ to the supports of the ring conductors generating the field is important. In this paper these two loss mechanisms are taken into account simultaneously. Smearing out the loss flux along $\underline{B}$ around the machine we get a simple differential equation for this loss, which is solved numerically together with a diffusion equation. Postulating FICK's law describing the diffusion we approximate the measured density profile by varying the diffusion coefficient. The best approximating coefficient is between resistive and Bohm diffusion but tends more to Bohm diffusion. Owing to the large ion gyro-radii in the inner part of the machine we consider ion–ion collisions, too. The diffusion equation obtained from this mechanism describes the measured profile very well, but does not lead to a unique relation between the adjusted flux from the particle source and the peak particle density for the operating regime. Author

N68-10650 Institut für Plasmaphysik G.m.b.H. Garching (West Germany).
THE PRESENT STATUS OF INVESTIGATIONS OF ELECTROMAGNETICALLY PRODUCED NON-STATIONARY SHOCK WAVES [DER HEUTIGE STAND DER UNTERSUCHUNGEN ELEKTROMAGNETISCHE ERZEUGTER INSTATIONAERER STOSSWELLEN]
H. Muntenbruch Apr. 1967 39 p refs In GERMAN; ENGLISH summary Presented at 6th Intern. Shock Tube Symp., Freiburg, 12–14 Apr. 1967 Supported by EURATOM
(IPP-3/58) CFSTI: $3.00

Fast shock waves in light gases can be simply produced by electromagnetic acceleration. Unlike rail spark gaps or magnetic annular tubes, which produce quasi-stationary shock-wave-like phenomena, T-tubes and conical theta-pinches or Z-pinches generate non-stationary shock waves of the blast wave type, if the plasma of the driving discharge does not advance right into the shock front and appreciably influence the plasma formed there. This paper is not so much a survey of investigations of the many variations of the driver systems mentioned above but deals rather with investigations of free-running shock waves and the distributions of the parameters in the plasmas behind these shock fronts. Shadowgraphs, interferograms, microwave interferograms and probe measurements have afforded a fairly complete picture of such non-stationary waves that reveals their uses and limitations. Author

N68-10762# Sydney Univ. (Australia). Wills Plasma Physics Dept.
PROPAGATION OF LARGE AMPLITUDE ALFVEN WAVES
R. C. Cross and C. N. Watson-Munro Apr. 1967 4 p refs
(NP-16891; ER-24)

The propagation of torsional hydromagnetic or Alfven waves in laboratory plasmas was studied for the case when the wave magnetic field b_ϕ is not small compared with the steady field B_ϕ. The results for perturbation ratios of b_ϕ up to 2.7 are reported. NSA

N68-10763# Sydney Univ. (Australia). Wills Plasma Physics Dept.
COMPRESSIONAL AND TORSIONAL WAVE MEASUREMENTS IN A DECAYING HYDROGEN PLASMA
R. C. Cross and J. A. Lehane Apr. 1967 4 p refs
(NP-16893; ER-26)

The propagation of both torsional and compressional waves in the same plasma is described. Measurements of velocity and

attenuation were made for several times throughout the life of a decaying plasma. The results show the change in the characteristics of the plasma as it decays, the effect of ion-neutral coupling on the wave propagation, and give some indication of the effect of the radial density distribution on the wave propagation. The measurements were made using the SUPPER II machine. NSA

N68-10787# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Institut voor Plasma-Fysica.

FIELD EQUATIONS FOR WAVES IN AN INHOMOGENEOUS WARM PLASMA WITH A FREQUENCY NEAR THE SECOND HARMONIC OF THE ELECTRON CYCLOTRON FREQUENCY

J. Rem and M. P. H. Weenink Apr. 1967 25 p Supported in part by EURATOM

(Rept.-67-37; NP-16979)

Equations are derived that described the electric fields inside the plasma when the frequency of the incident wave is in the neighborhood of the second harmonic of the cyclotron frequency. The equations were derived by two methods, one consisting of integration of the Vlasov equation along the unperturbed orbits of the particles and the other starting from the moment equations. (NSA)

N68-10789# Los Alamos Scientific Lab., N. Mex.

HOLLOW-CATHODE ARCS: LITERATURE SURVEY [LES ARCS A CATHODE CREUSE. MISE AU POINT BIBLIOGRAPHIQUE]

Claude Breton Mar. 1967 43 p refs Transl. into ENGLISH from C.E.A. Bibliog. (France), no. 88, Mar. 1967 28 p

(LA-TR-67-74; CEA-BIB-88)

Arc discharges have been studied for a large number of years in a wide range of operational conditions. The idea of using hollow electrodes, a magnetic field and a constant axial gas-stream appears to have resulted from work carried out at Oak Ridge in about 1955. Since then, hollow cathode or anode arcs have been further developed. Phenomena connected with the cathode have, however, been little studied. The object of this work is to review this particular field of a type of arc having remarkable properties. Author (NSA)

N68-10841 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.

THE HYDROMAGNETIC BOUNDARY LAYER PROBLEM WITH AN ALIGNED MAGNETIC FIELD AND LARGE MAGNETIC REYNOLDS NUMBERS

P. Ramamoorthy [1966] 27 p refs

(AE-137A) CFSTI: $3.00

The boundary layer equations governing the steady flow past a semi-infinite flat plate of an incompressible and highly conducting liquid with an aligned magnetic field are integrated on analogue and digital computers. This report gives the numerical values for the velocity and the magnetic field among other things. Certain consequences of these numerical results have been discussed. Author

N68-10874# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands).

MONOTONICITY OF THE STABILITY CRITERION FOR A PINCHED FLUID WITH A LONGITUDINAL MAGNETIC FIELD

C. Bobeldijk Apr. 1967 7 p refs

(NP-16976; Rept.-67-39)

Normal mode analysis applied to perturbations of a pinched fluid with a longitudinal magnetic field leads to a well-known stability criterion. It is proved that the ω-dependent part of this criterion increases monotonically with the growth rate ω. Author (NSA)

N68-10877# United Kingdom Atomic Energy Authority, Culham (England).

INVESTIGATION OF A TITANIUM PLASMA SOURCE. VOLUME 2: MASS COMPOSITION, ENERGY SPECTRUM, AND PURIFICATION OF THE PLASMA

E. D. Andryukhina and I. S. Shpigel' 1966 11 p Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSSR, (Moscow), v. 32, 1966 p 39–45

(CTO-352; NP-TR-1553)

Data are given on the mass composition of the plasma, the dynamics of the occurrence of impurities, and the structure of the plasma jet. The investigation was done using a mass spectrometer. The plasma source operated under aperiodic or oscillating discharge conditions. In the first case, a damping resistance of corresponding magnitude was introduced into the discharge circuit. The capacitance feeding the source was 1.65 μF. The wave impedance of the discharge circuit was 0.32 ohms, and the period of oscillation under oscillating conditions was 3.2 μsec. Based on the experimental data, a table shows the dependence of the parameters of the plasma on the operating conditions of the source under aperiodic conditions, and a second table gives the same data for oscillating conditions. NSA

N68-10889 Lockheed Missiles and Space Co., Palo Alto, Calif.

ON THE NONLINEAR THEORY OF THE PASSAGE OF ELECTROMAGNETIC WAVE PULSES THROUGH A PLASMA BOUNDARY

V. N. Tsytovich and V. D. Shapiro [1967] 10 p refs Transl. into ENGLISH from the "High-Frequency Properties of Plasma" Kiev, Nauk. Dumka Press, 1967 p 34–46

A theoretical discussion is presented of the dynamics of the passage of monochromatic and diffuse electromagnetic wave pulses. The role of boundary effects is investigated, and both narrow and broad spectra are considered. Stochasticity of phase of the transverse and generated longitudinal waves is assumed. It is pointed out that the boundary effects may be utilized to generate longitudinal waves and for turbulent plasma diagnostics. N.E.N.

N68-10891 Technische Hochschule Hannover (West Germany).

DERIVATION AND ANALYSIS OF A KINETIC EQUATION FOR SPATIALLY HOMOGENEOUS SYSTEMS WITH COLLECTIVE INTERACTION [ABLEITUNG UND UNTERSUCHUNG EINER KINETISCHEN GLEICHUNG FUER RAEUMLICH HOMOGENE SYSTEME MIT KOLLEKTIVER WECHSELWIRKUNG]

Ruediger Bessenrodt (Ph.D. Thesis) 1965 110 p refs In GERMAN

The Born–Bogoliubov–Green–Kirkwood–Yvon hierarchy for single-component systems is derived from the Liouville equation, and individual and collective change effects are separated. The two parts on the right side of the resulting kinetic equation are transformed into a Boltzmann shock integral and Fokker–Planck terms. The coefficients contained in the Fokker–Planck terms are calculated for the case of the Coulomb force and the thermodynamic balance and are subsequently used to state the kinetic equation. Fulfillment of the conservation laws and the H theorem for the resulting condition are proven, and the stationary and asymptotic solutions are derived. Location correlations of the particles in the Fokker–Planck terms are examined, which requires proof of the

upper and lower limits of the distance integrations in these terms and explicit calculation of the two-particle distibution. The method is generalized for multiple-component systems, and application is demonstrated by calculating the Fokker–Planck coefficients, two-particle distributions, viscosity, and thermal conductivity of a completely ionized hydrogen plasma and also the interaction of two ionized components with different flow velocities. Transl. by K.W.

N68-10892# Institut für Plasmaphysik G.m.b.H., Garching (West Germany)

THE ELECTRICAL CONDUCTIVITY IN ARGON POTASSIUM AND HELIUM POTASSIUM PLASMAS WITH ELEVATED ELECTRON TEMPERATURES IN CROSSED ELECTRIC AND MAGNETIC FIELDS

G. Brederlow and R. Hodgson Sep. 1967 30 p refs
('PP-3/59) CFSTI: $3.00

Methods and results of measurements of the tensor conductivity and electron temperatures in argon potassium and helium potassium plasmas with elevated electron temperatures under MHD generator conditions are described. Electrode and wall effects that would make the measurements more difficult to interpret have been eliminated. Calculations predict that the scalar electrical conductivity should drop slightly with increasing magnetic field strength. However, the measured effective scalar conductivity was less than the theoretically predicted value. The discrepancy is apparently due to instabilities. These instabilities were investigated. At current densities and field strength values at which instabilities were observed, the effective Hall coefficient has been found to be nearly independent of the magnetic field strength. The measurements have shown that the efficiency of a noble gas MHD generator is adversely affected not only by the decrease of the scalar conductivity in a magnetic field, but also by the onset of instabilities. Author

N68-10893 Institut für Plasmaphysik G.m.b.H., Garching (West Germany).

SURVEY OF THE LINEAR THETA PINCH WORK IN GARCHING

E. Fuenfer Aug. 1967 39 p refs Am. Phys. Soc. Topical Conf. on Pulsed High Density Plasmas held in Los Alamos, N. Mex., 19–22 Sep. 1967
(IPP-1/70) CFSTI: $3.00

The main objectives studied are very hot, high β-plasmas, and collisionless compression and turbulent heating. Low filling densities down to 10^{12} cm^{-3} are required and preionization becomes a severe problem. Therefore theta pinch with dynamically confined plasma, the high-voltage z-pinch with short current pulse and the photoionization by strong ultraviolet radiation. In the main discharge highly anisotropic plasmas with ion temperatures of several keV can be observed. The time behavior of the anisotropy is compared with theoretical considerations. Electron temperatures of some 100 eV were found by laser scattering experiments. The values from X-ray absorption were much higher and not reproducible. Coherent laser scattering at 90° with a theta pinch of high density and low temperature allowed the measurement of spectrally resolved ion and satellite lines. The influence of mirrors on end losses and stability has been studied. The plasma remains stable in the low pressure regime for a low impurity level. Author

N68-10907# Los Alamos Scientific Lab., N. Mex.

INDUCTION COIL AS A MEASURING ELEMENT IN FAST CURRENT INTENSITY GAS DISCHARGE [INDUKTIONSSPULEN ALS MESSELEMENTE AN SCHNELLEN, STROMSTARKEN GASENTLADUNGEN]

W. Koeppendoerfer 1 Nov. 1961 29 p Transl. into ENGLISH from German
(LA-TR-67-38; IPP-1/2)

The equations describing the dimensions and characteristics of an induction coil used as a measuring element in fast high current gas discharges are derived. The Rogovski coil is considered and the magnetic field probe is given. The characteristics of the measurement circuit are derived. The shielding necessary and the calibration of a measurement coil are considered. Author (NSA)

N68-10921# United Kingdom Atomic Energy Authority, Culham (England).

INVESTIGATION OF A TITANIUM PLASMA SOURCE. VOLUME I: CONSTRUCTION OF THE SOURCE AND MAIN PARAMETERS OF THE PLASMA

S. N. Popov Jan. 1967 16 p refs Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSSR (Moscow), v. 32, 1966 p 29–38
(CTO-351; NP-TR-1554) CFSTI: HC $3.00/MF $0.65

The source is in the form of a row of titanium disks, with a diameter of 14×19 mm and a thickness of 2 mm, fed with hydrogen or deuterium. The distance between the disks was 1 mm. The ohmic resistance of the conducting electrodes did not exceed 0.02 to 0.03 ohms, and the conductance of the source under operating conditions, assuming that the plasma pinch completely fills the inner channel of the source, was approximately 30 cm. Using the above equipment, studies were made of several parameters of the plasma generated: density, total number of particles generated, mass and energy spectra, temperature of the electrons and the ions, etc. A figure shows the distribution of the ions with respect to transverse velocities, and a table shows the mean free flight path of ions in the plasma. NSA

N68-10945# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Aero Propulsion Lab.

EXPERIMENTAL COMPARISON OF CONVENTIONAL-HOLLOW AND COAXIAL-HOLLOW CATHODE LOW-PRESSURE ARCS

Ellsworth L. Boyer and James F. Holt Jun. 1967 21 p refs
(AFAPL-TR-67-63; AD-659124)

A one-meter coaxial-hollow cathode argon arc was investigated experimentally and the results obtained were compared with already-documented data on conventional-hollow cathode low-pressure argon arcs. The outer diameter and inner diameter of the hollow cathode, used for comparison purposes, were 1.91 and 0.953 centimeters, respectively, while the outer diameter of the coaxial cathode was 1.91 centimeters and its inner diameter was 1.27 centimeters. Radial profiles of the electron temperature and density in the arc plasma were measured by a Langmuir probe; current profiles were measured by an electrical profile scanner device. A plasma sweeper provided data on electron density. The data obtained by all methods for the low-pressure arc of the coaxial-hollow cathode were consistent in repeated tests and consistent with the data available on the low-pressure arc of the conventional-hollow cathode. The maximum electron temperature was 4.8 electron volts; the electron density average for the arc column was 3 x 10 to the 12th power per cu cm. With the coaxial arrangement for a cathode of any fixed dimensions, the coaxial type can be run at higher power than a conventional single-element hollow cathode of the same dimensions. Author (TAB)

N68-10955 Lockheed Missiles and Space Co., Palo Alto, Calif.
METHODS OF MICROWAVE AND OPTICAL INTERFEROMETRY OF PLASMA
Iu. E. Nesterikhin and R. I. Soloukhin [1967] 10 p Transl. into ENGLISH from the book "High-speed Measurement Methods in Gasdynamics and Plasma Physics" Moscow, Nauka Press, Chapter 7, 1967 p 129–141

High speed recording instruments for gas dynamics and plasma measurements are described. Details are given on a high speed microwave recorder which permits recording the Doppler frequency shift under oblique incidence of an electromagnetic wave on a moving conducting surface. A circuit for simultaneous measurement of plasma concentration and the effective conductivity uses an interferometer to record the phase shift and amplitude of a microwave probe signal on the same oscillogram. Optical interferometry methods are also discussed, emphasizing the Michelson type for simultaneous recording of the interference fringes and a picture of the plasma. N.E.N.

N68-10957# Montreal Univ. (Quebec).
REPORT OF ACTIVITIES, OCTOBER 1966–OCTOBER 1967 [RAPPORT D'ACTIVITE, OCTOBRE 1966–OCTOBRE 1967]
Oct. 1967 refs 92 p refs In FRENCH *Its* No. 4
CFSTI: HC $3.00/MF $0.65

This year, several important changes have been made in the orientation of the research program. This is reflected in the areas under which the various studies have been grouped: (1) Experimental study of various diagnostic techniques, (2) study of glow discharges, (3) multigrid analyser for determining the derivative of the energy spectrum of slow electrons, (4) experimental study of magnetoplasmas and (5) Theoretical study of plasmas. Author

N68-10982 Lockheed Missiles and Space Co., Palo Alto, Calif.
SOLITARY IMPULSE OF A LONGITUDINAL WAVE IN A PLASMA
V. B. Krasovitskii [1967] 4 p refs Transl. into ENGLISH from the book "High-Frequency Properties of Plasma" Kiev, Nauk. Dumka Press, 1967 p 46–49

A short mathematical discussion is presented on the solitary longitudinal wave, and it is shown that the wave may exist in a cold electron plasma in the absence of charge-density jumps. A solution is given of a system of equations including hydrodynamic equations of motion, the continuity equation for the plasma particles, the kinetic equation for the particles trapped by the impulse, and the Poisson equation. An electron–positron plasma is also considered, and it is found that solitary impulse waves with trapped electrons may exist in it. N.E.N.

N68-11000*# Stanford Univ., Calif. Inst. for Plasma Research.
A TEST-PARTICLE ANALYSIS OF PLASMA TURBULENCE IN ASTROPHYSICS
Donald Eugene Hall Jun. 1967 124 p refs
(Grant NsG-703)
(NASA-CR-90213; SU-IPR-192) CSCL 20I

To investigate the origin of charged high-energy particles, an idealized problem has been studied. Test particles are pictured in a general configuration of steady or slowly changing electromagnetic fields, to which an arbitrary spectrum of small random fluctuations is added to represent weak plasma turbulence. The behavior of particles is found in terms resembling the quasi-linear theory of plasma disturbances, and advantages of this method over the previously used Fokker–Planck approach are described. The limits of applicability of the theory are stated and explained. The particular case considered in detail is that of relativistic particles moving in stochastic fields in an otherwise uniformly magnetized plasma. Transverse cyclotron acceleration by low-frequency waves is proposed as the most significant process of stochastic acceleration. The relevant properties of quasars are reviewed and preliminary comparison is made between the model calculations and the observational data. It is concluded that stochastic acceleration is important in the generation of high-energy particles. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-10087# Uppsala Univ. (Sweden). Inst. of Physics.
DE HAAS–VAN ALPHEN EFFECT IN p-TYPE Sb_2Te_3
H. Schwartz and G. Bjoerck Apr. 1967 22 p refs Sponsored in part by the Swed. Nat. Sci. Res. Council
(Contract AF 61(052)-937)
(UUIP-532)

The Fermi surface of Sb_2Te_3 ($n = 7.5 \times 10^{19}$ holes/cm^3) was studied by the dHvA effect. Ellipsoidal bandshape was verified. With the ellipsoids centered on mirror planes and the bisectrix taken as the x axis the components of the reciprocal effective mass tensor were: $Alpha_{11} = 0.75 \times 10^{14}$ E_F; $Alpha_{22} = 1.50 \times 10^{14}$ E_F; $Alpha_{33} = 0.76 \times 10^{14}$ E_F; $Alpha_{13} = 0.75 \times 10^{14}$ E_F. Author (NSA)

N68-10097*# Rice Univ., Houston, Tex.
[RESEARCH ON THE PHYSICS OF SOLID MATERIALS] Semiannual Status Report, 1 Nov. 1966–30 Apr. 1967
[1967] 36 p refs
(Grant NsG-6-59)
(NASA-CR-89535; SASR-16) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Continuing research is reported in the field of solids. Progress in understanding defect structure and mechanical properties is described for the following areas: plastic deformation of body-centered cubic crystals; the relation between short-range order in alloys and their electrical resistivity; microstrain, microcreep, and amplitude dependent dislocation damping in metal crystals; ultrasonic attenuation of LiF crystals between 2° and 300°K; and stage I deformation in Hexagonal close-packed crystals. The research on the behavior of matter in static and alternating electromagnetic fields and emphasized the static and low frequency, microwave and optical properties, and X-ray–gamma ray interactions. Microwave magnetic resonance and nonresonant absorption in single crystals of dysprosium were also investigated, and conductivity studies are mentioned. Structural, thermodynamic, kinetic, and optical characterizations of bulk solids and solid-gas interface are discussed. The properties, flux reversal mechanisms, and manufacturing of thin ferromagnetic films are described. N.E.N.

N68-10098* Case Inst. of Tech., Cleveland, Ohio.
IMPURITIES AND INTERFACE STATES IN THE SiO_2/Si SYSTEM Final Report
Alan B. Kuper 1 Oct. 1967 55 p refs
(Grant NGR-36-003-067)
(NASA-CR-90046) CSCL 20L

This study is concerned with improving the reliability of silicon planar microcircuitry. Work is reported on: (1) phosphosilicate

glass passivation against sodium; (2) theory of charged impurities in oxide on Si; (3) hydration of thermal oxide on Si; (4) gold in the SiO_2/Si system; and (5) interface states in SiO_2/Si. Principal new results are: (1) P_2O_5 glassing not only getters Na from SiO_2, but also neutralizes Na *within* SiO_2, even at Na concentrations of $\approx 10^{18}$ cm^{-3}; (2) a comparison of charge distribution models with impurity distributions in SiO_2 on Si showed that a large part of Na in the oxide is neutral, that pile-up of Na in the oxide at the Si results from image charge electrostatic attraction, and that Na may be in steady-state association/dissociation with negative charges in the oxide; (3) a model for Si surface potential instability; (4) interface state experiments at 77°K resulting in a capacitance plateau in the depletion portion of C(V) characteristics, a useful measure of interface state concentration, and large hysteresis in the depletion portion in the dark, of opposite sense for n- and p-type, useful in measuring charge relaxation from interface states. The hysteresis phenomenon is thought to have device possibilities both as a bistable and as an image sensor. K.W.

N68-10101# Technische Hochschule in Wien (Austria). Institut für Angewandte Physik.

THE SYSTEM NEODYMIUM—MANGANESE (STRUCTURES, MAGNETIC PROPERTIES, PHASE DIAGRAM) THE PHASE DIAGRAMS Yb–Hb– AND Tb–Hg

Franz Lihl 20 Jun. 1967 26 p refs
(Contract AF 61(052)-942)
(SR-2; AD-658216)

The system Nd–Mn was investigated by X-ray diffraction, X-ray fluorescence analysis, differential thermal analysis and magnetic analysis. The phases present were determined and their structures established: Nd6Mn23 possesses the Th6Mn23, NdMn12 the ThMn12 structure. The magnetic properties of NdMn2, Nd6Mn23 and NdMn12 could be evaluated. Nd6Mn23 is ferromagnetic, NdMn12 is antiferromagnetic. By measurements of the magnetization and of the susceptibility the Mu- and Mu(eff)-values could be determined. By differential thermal analysis and by the Amalgam process the systems Tb–Hg and Yb–Hg could be evaluated. The phases TbHg, TbHg2, TbHg2, YbHg, YbHg2 and YbHg3 could be prepared mostly for the first time and their structures have been determined. Both binary Hg-systems of Tb and Yb are similar. Altough the Tb–Mn and Yb–Mn systems differ considerably. Author (TAB)

N68-10105# California Univ., La Jolla. Dept. of Physics.

THEORY OF THE EXCITONIC INSULATOR IN THE PRESENCE OF NORMAL IMPURITIES

Johannes Zittartz 21 Jun. 1967 30 p refs
(Contract Nonr-2216(11))
(TR-46; AD-657610)

Recently several papers have discussed the possibility of a new kind of insulating phase in semimetals or semiconductors with small band gap. This phase can be described as a condensate of electron-hole pairs (excitons) due to an effective interaction between valence and conduction electrons. This paper extends the analysis of the excitonic phase in the semimetallic region in the presence of randomly distributed normal (i.e. nonmagnetic) impurities. It is shown that the impurities have a pair-breaking effect similar to the case of magnetic impurities in superconductors. The Abrikosov-Gorkov theory developed for the latter case is applied with minor modifications to the excitonic phase. It is shown that beyond a critical impurity concentration the excitonic phase cannot exist. Changes in the transition temperature and in the order parameter are calculated as well as the density of states. It is found that in a region close to the critical concentration the excitation spectrum of the system has no energy gap. Author (TAB)

N68-10159# General Electric Co., Philadelphia, Pa. Missile and Space Div.

RADIATION ABSORPTION IN SOLIDS

R. B. Thomas Oct. 1967 31 p refs
(R67SD55)

The mechanism by means of which electromagnetic radiation is absorbed in matter depends to a very large extent on the frequency of the radiation. For energies above the optical range the processes are essentially quantum mechanical in nature and result from the interaction of energy quanta (photons) with particular atoms and molecules composing the solid. This seems reasonable, when it is realized that there is a distinction between the intensity of the radiation, by which is meant the magnitude of the energy flux, and the energy of the individual quanta making up the energy flux. There are three processes which are principally responsible for the absorption of radiation in solids: photoelectric absorption, Compton effect, and pair production. Each is discussed in some detail. Author

N68-10161# France. Ministere de l'Air, Paris.

THERMAL DIFFUSION, ELECTRICAL DIFFUSION AND IONIC CONDUCTABILITY IN IRON PROTOXIDE [DIFFUSION THERMIQUE, DIFFUSION ELECTRIQUE ET CONDUCTIBILITE IONIQUE DANS LE PROTOXYDE DE FER]

Philippe Desmarescaux Serv. de Doc. Sci. et Tech. de l'Armement 1967 95 p refs In FRENCH *Its* No. 434

The diffusion of iron was investigated to study the ionic conduction of ferrous oxide. The mechanism of ionic displacement was postulated from the experimental data. Thus, a novel purification method was elaborated for metals by the electromigration of ions within their oxides. Metal protection against thermal oxidation was assured by conveying an electric current through the oxide film under formation. Transl. by T.Z.D.

N68-10171# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.

STABILITY AND SPATIALLY PERIODIC MAGNETIZATION OF HARD SUPERCONDUCTORS

Yukikazu Iwasa (Ph.D. Thesis) May 1967 145 p refs
(Contract AT(30-1)-3700)
(MIT-3700-6) CFSTI: HC $3.00/MF $0.65

The nature of flux jumping and associated phenomena, particularly the stability of hard superconductors, has been investigated. The most significant experimental result is the direct observation of the formation of the spatial periodicity of magnetization, viz., the macrovortex structure, in samples of magnetized unclad hard superconducting wire in ambient magnetic fields smaller than 35 kilogauss. A satisfactory explanation for the formation of macrovortices has been formulated. The formation of macrovortices involves a mechanism of energy concentration, in which the energy of magnetization stored uniformly over a finite volume is dissipated preferentially in a local region during the process of flux jumping, thereby raising the temperature of the region to the critical temperature. The balance of the energy of magnetization and the thermal energy associated with the change in temperature of the sample governs the process of flux jumping. The balance of these two energies is the principle that also applies to the interpretation of other experimental results, including those obtained from experiments on samples of copper-clad wire. Experiments have shown that macrovortices are apparently not formed in samples of copper-clad wire. The stability of hard superconductors has been investigated from the standpoint of their susceptibility to flux jumping. A quantitative criterion for their instability has been derived. In accordance with the criterion several metals have been examined as possible alternatives to copper as cladding materials for the suppression of flux jumping. It is found that it may be

possible to stabilize a superconductor completely against flux jumping by the use of such metals as mercury or lead whose volumetric thermal capacity is much greater than that of copper. A smaller amount of these materials than of copper would be required to give a prescribed degree of stability to a superconductor. If flux jumping is completely eliminated, it should be possible to eliminate the phenomenon of current degradation. Author (NSA)

N68-10193 Lockheed Missiles and Space Co., Palo Alto, Calif.
GROWING LEAD TELLURIDE CRYSTALS OF STOICHIOMETRIC COMPOSITION IN THE VAPOR-GAS PHASE
T. A. Mashaev, V. V. Krapukhin, and S. P. Pavlov 1967 7 p refs Transl. into ENGLISH from the book "Chalcogenides" Kiev, Nauk.-Dumka, 1967 p 101–107

Preliminary results are given for growing lead telluride crystals of homogeneous composition from the vapor gas phase in a high vacuum. The electrical properties and thermal emf of lead telluride are briefly reviewed. A method for determining lead telluride vapor pressure at high temperatures is described which involves saturation of an inert gas flow by vapors of the investigated material. Reaction chamber construction and the vacuum sublimation process are also described. Chemical and X-ray analyses of the lead crystals produced support the possibility of obtaining homogeneous material of almost stoichiometric composition. E.C.

N68-10228* Farnham (Frank C.) Co., Philadelphia, Pa.
THE G-FACTORS OF F-CENTERS IN ALKALI-HALIDE CRYSTALS [DER G-FAKTOR VON F-ZENTREN IN ALKALIHALO-GENID-KRISTALLEN]
D. Schmid Washington NASA 1967 17 p refs Transl. into ENGLISH from Phys. Status Solidi, v. 18, no. 653, Jun. 1966 p 653–666
(Contract NASw-1497)
(NASA-TT-F-11278) CFSTI: $3.00 CSCL 20L

The g-factors of F-centers in various alkali halides have been determine by electron-spin-resonance measurements at 24,000 MHz, giving g-factor shifts between 5×10^{-4} for LiF and 5.3×10^{-2} for RbI. These shifts can be explained by means of a model proposed by Adrian, in which the unpaired electron experiences a spin-orbit coupling in the electric field of the neighboring nuclei. Numerical calculation of g-factor shifts is facilitated by use of the measured anisotropic hyperfine structure constants b. This leads to satisfactory agreement if the g-shift is mainly due to spin-orbit coupling at the nearest-neighbor cations. However, as the contribution of the next-nearest-neighbor anions increases, the agreement becomes worse. In the case of aligned lithium-F_A-centers in KCl, an anisotropic g-factor was observed. The experimental value of $g_T-g_\parallel$ was found to be $(11\pm4)\times10^{-4}$, which agrees well with the calculated value of 9×10^{-4}. Author

N68-10300*# Melpar, Inc., Falls Church, Va.
AMORPHOUS SEMICONDUCTORS Final Report, 10 Jun. 1964–2 Aug. 1967
2 Aug. 1967 31 p refs
(Contract NASw-934)
(NASA-CR-89982) CFSTI: HC$3.00/MF$0.65 CSCL 20L

The electrical and optical properties of amorphous thin films, including selenium, germanium, silicon, and boron, were investigated to determine the relation between amorphous and crystalline materials. Results show that there appear to be certain optical and electrical properties of amorphous thin films which are characteristic of several different materials, and that certain characteristics of crystalline thin films agree with those of single crystal bulk material. The optical study of boron films failed to show any noticeable structure out as far as 9.0 eV. The absorption continued to rise, and in the near infrared, impurity levels were found to be optically active. It was concluded that there is little modification in the band structure between crystalline and amorphous boron and germanium. The electrical studies of boron and other semiconductor materials showed a number of different conduction mechanisms, but these are similar to crystalline materials. As voltage increases, these go from ohmic to space charge limited to avalanche conduction mechanisms before switching occurs. R.N.A.

N68-10442# Saint Mary's Coll., Winona, Minn.
EXPERIMENTAL STUDY OF THE SURFACE STRUCTURE AND ELECTRONIC PROPERTIES OF SINGLE CRYSTAL MOLYBDENUM AND TUNGSTEN RIBBONS Progress Report, 1 Nov. 1966–1 Aug. 1967
Donald R. Morgan and William E. Blass 7 Aug. 1967 13 p refs
(Contract AT(11-1)-1417)
(COO-1417-3) CFSTI: HC$3.00/MF$0.65

Further improvements in methods for preparation of Mo and W single crystals were made. Cutting of the crystals by electric-discharge machining and refining of grinding and polishing procedures considerably improved the size and quality of the crystals. The LEED (low-energy electron diffraction) system was modified by an improved set of Helmholtz coils, which reduce the earth's magnetic field in the diffraction chamber to 10^{-3} gauss so that low-voltage electrons are essentially undeflected in the chamber. The system now works consistently with a range of electron energies from 20 to 750 eV available. Studies of crystal cleaning were carried out on a (110) Mo crystal ribbon and a (100) Mo ribbon. Lead patterns were obtainable from nonelectropolished Mo crystals. The (110) surface of Mo appeared to be highly stable relative to contamination since at pressures of $\approx5\times10^{-10}$ torr, patterns remained on the surface for several hundred hours after 1900°C cleanings while the (100) surface sustained a LEED pattern for approximately 15 hr after 1900°C cleanings. Some difficulty was experienced with the vacuum system used for the retarding potential experiment. The vacuum chamber was modified and the internal structure for these experiments completed. NSA

N68-10468# Brookhaven National Lab., Upton, N. Y.
SEMICONDUCTOR LIFETIME MEASURING APPARATUS
E. J. Rogers [1967] 5 p
(BNL-11645) CFSTI: HC$3.00/MF$0.65

An apparatus is described which measures the minority carrier lifetime of the germanium used in solid-state radiation detectors. Minority carriers are generated in a sample slab of the material by photo-excitation from a pulsed neon lamp while a steady current is applied to the slab. The voltage signal across the slab is monitored by an oscilloscope so that minority carrier decay can be observed directly. NSA

N68-10471# Iowa State Univ. of Science and Technology, Ames.
FIELD MODULATION STUDIES OF THE DE HAAS-VAN ALPHEN EFFECT IN NICKEL
Dennis Ray Stone (Ph.D. Thesis) May 1967 98 p refs
(Contract W-7405-ENG-82)
(IS-T-169) CFSTI: HC$3.00/MF$0.65

The de Haas–van Alphen effect was studied in spherical nickel crystals in fields up to 63 kOe and at temperatures as low as 1.1°K using a low frequency (≈40 Hz) field modulation technique. These measurements showed that the field modulation technique could be used for ferromagnetic samples provided that

the modulation frequency was less than 25 kHz and that the modulation field was parallel to the applied field direction. The observed de Haas–van Alphen oscillations are interpreted as arising from two distinct sheets of Fermi surface—one, a multiply connected cooper-like sheet centered at the point Γ in the zone and, the other, a set of equivalent fluted ellipsoids situated at the symmetry points X in the zone. These surfaces were interpreted in terms of the band structure predicted by L. Hodges and it has been shown that these measurements are in complete accord with these new calculations. Author (NSA)

N68-10492# California Univ., Riverside. Dept. of Chemistry.
ORGANIC MOLECULAR SOLIDS. Final Report
David R. Kearns. 20 Aug. 1967. 33 p. refs
(Grant DA-ARO(D)-31-124-G405)
(Rept.-3896.6-P; AD-659401) CFSTI: HC $3.00/MF $0.65

Experimental evidence was found for transport of electronic excitation energy in pyrene crystals by trivial transfer, excimer exciton migration, and monomer migration. The relative importance of these various transfer mechanisms depends upon the geometry of the sample, the nature of the acceptors, the acceptor concentration, and the temperature. Trivial transfer was important in the perylene doped samples, but not in the samples containing azulene as the acceptor. The photogeneration of free electrons in the short wavelength region is shown to involve a direct optical transition to a conducting state of the pyrene crystal with a threshold of approx. 4.1 ev. Hole generation in the short wavelength region involves comparable contributions from an intrinsic, as well as an extrinsic, impurity dependent process. Long wavelength generation of holes involves migration of mobile monomer singlet excitons to the surface of the crystal where ionization occurs. TAB

N68-10505 Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Metallurgie.
DECREASE OF MOSSBAUER RECOIL-FREE FRACTION IN SMALL TUNGSTEN PARTICLES
R. Roth and E. M. Hoerl. Jul. 1967. 6 p. refs
(SGAE-M-9/1967) CFSTI: $3.00

The Debye–Waller factor of tungsten microcrystals was investigated by the Mössbauer technique and found to decrease with particle size. The results are discussed in terms of the Debye model as well as in terms of a modified Debye model. Author

N68-10536# Princeton Univ., N. J. Solid State Electronics Lab.
A MEASUREMENT OF THE HALL EFFECT IN METAL FREE PHTHALOCYANINE
M. Rona and G. Warfield. Sep. 1966. 46 p. refs
(Contract DA-31-124-ARO(D)-191; Grant NSF GP-579; ARPA Order 462)
(TR-9; AD-659395)

The Hall Effect was measured in a metal free phthalocyanine crystal in the b direction over the temperature range 46C to -6C, using a differential detection technique. The observed Hall constant was negative in sign, and its temperature dependence indicated that the band theory rather than a phonon assisted hopping mechanism should be considered to describe the electrical conduction in this direction. A passive four terminal model which facilitates the compensation for detector loading in the Hall effect measurements on highly resistive samples is proposed. Author (TAB)

N68-10548# Pennsylvania State Univ., University Park. Materials Research Lab.
RELATION OF MECHANICAL PROPERTIES TO THE STRUCTURE OF IONIC SOLIDS. Quarterly Report, 1 Jun.–31 Aug. 1967
K. Vedam and R. E. Newnham. 15 Sep. 1967. 17 p. refs
(Contract DA-19-0660-AMC-325(X))
(AMRA-CR-66-07/5; QR-5; AD-659414)

The crystal structure analysis and least squares refinement of fluorophlogopite were completed. Detailed analysis of the data clearly indicates that the space group of fluorophlogopite is C2/m. The final R factor obtained with this space group using the counter data and the range estimate weighting scheme is 6.1%. A detailed discussion of the structure in terms of the various bond distances, bond angles and thermal vibrational parameters, is given. A brief summary of the results obtained from the Berg-Barrett x-ray diffraction patterns of the micas under various experimental conditions, is also given. Author (TAB)

N68-10586# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ELECTRON ENERGIES AND EFFECTIVE PAIRWISE INTERACTIONS IN A BINARY ALLOY OF SIMPLE METALS
Timothy Mitchell Hayes. Aug. 1967. 183 p. refs
(Contract ARPA SD-88)
(ARPA-30; AD-659493)

The pseudopotential formalism which has been developed to calculate the properties of periodic crystals is extended to treat the case of a binary alloy with an arbitrary degree of order. A self-consistent screening potential which includes the effect of the total conduction electron charge is derived to first order in a perturbation theory expansion in the pseudopotential. The conduction electron contribution to the total energy of the crystal is expressed to second order in the pseudopotential. The applicability of these perturbation theory expansions is discussed extensively. Expressions for the part of the conduction electron energy which contributes to the ordering energy and for the effective pairwise interactions between the ions in the alloy are derived from the expression for the total energy. If the conduction electron energy may be expressed accurately to second order in the pseudopotential, we demonstrate that this energy depends only upon correlations between pairs of ions. Otherwise, accurate individual electron energies near band gaps are shown to depend upon correlations between three or more ions for an alloy below its critical temperature. The procedure for selecting an optimal form for the pseudopotential is examined in detail. A Hermitian pseudopotential is chosen and its advantages are discussed. Our calculations on a 50-50 alloy of lithium and magnesium indicate that the selection of an appropriate pseudopotential is quite important. Author (TAB)

N68-10631 Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
CORRELATION FUNCTIONS IN THE THEORY OF SUPERCONDUCTIVITY
N. N. Bogolubov, Jr. 1967. 88 p. refs. Submitted for publication
(ITF-67-1)

The asymptotically exact calculation of the free energy for the Bardeen-type model system is considered in detail, and the more complicated problems of estimating the differences between two correlation functions and between two Green functions are investigated, the latter being constructed on the basis of the model and the approximate Hamiltonians. NSA

N68-10671* TRW Systems, Redondo Beach, Calif.
STUDY HIGH DIELECTRIC CONSTANT THIN FILM CAPACITOR MATERIALS PROJECT SUMMARY, 1 FEBRUARY 1966–31 OCTOBER 1967
R. P. Radke 31 Oct. 1967 255 p refs
(Contract NAS9-5592)
(NASA-CR-65805) CSCL 20L

High vacuum deposition was studied as an approach to fabricating thin film capacitors with high specific capacitances in order to permit reductions in the size of microcircuits. Based on a literature survey of material properties, investigation was limited to sodium niobate, solid solution of barium zirconate, and solid solution of lead zirconate. Laser, electron bombardment, flash evaporation, and dual evaporation depositional techniques were assessed. Optical and electron microscope, X-ray diffraction, and spectrographic analyses were used to establish the physics, crystallography, and chemistry of the resultant thin films. The electrical characteristics were determined with regard to temperature coefficient of capacitance, specific capacitance, dielectric constant, frequency response, voltage breakdown, and stability. Further efforts were made to improve the voltage breakdown characteristics and the repeatability of $NaNbO_3$ capacitors. Although higher voltage breakdown characteristics were achieved, it is pointed out that the usability of the capacitors fabricated by the processes evolved is marginal. M.G.J.

N68-10700# Cornell Univ., Ithaca, N. Y.
STUDY OF LOCALIZED MAGNETIC MOMENTS BY ELECTRON PARAMAGNETIC RESONANCE
David C. Langreth (Rutgers Univ., New Brunswick, N. J.), David L. Cowan, and John W. Wilkins Sep. 1967 12 p refs
(Contract Nonr-401(38))
(NYO-2150-38; Rept.-793; TR-23; AD-659193)

Recent transmission paramagnetic resonance has been applied to a dilute magnetic alloy Cu:Mn. A number of years ago, Hasegawa showed how resonance in dilute alloys could be understood by writing down a set of phenomenological Bloch-like equations. However, aside from the ambiguities mentioned by Hasegawa himself, the equations do not describe the respective effects of the Kondo anomoly, the hyperfine interaction, nor of conduction electron diffusion. The latter difficulty is easily remedied. This report concentrates on the effects of the hyperfine and s-d interactions. TAB

N68-10715# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.
THERMAL CONDUCTIVITY MEASUREMENTS OF EuO ACROSS THE CURIE POINT
John Ligon Cason, Jr. (M.S. Thesis) 1 Oct. 1967 85 p refs
(Contract Nonr-2964(01))
(TR-22; AD-659181)

The investigation represents the first measurements of the thermal conductivity K of the magnetic semiconductor EUO. The measurements were carried out through the Curie point in the temperature range 55–300K. The sample used was a hot-pressed powder 90% EUO and 10% EU_2O_3 2.9 mm diameter and 19 mm long. Values of K ranged from 14 Mw/cm-deg at 260K to 24 Mw/cm-deg at 96K to 22 Mw/cm-deg at 64K with a sharp dip by a factor of four in the thermal conductivity near 69K. The results indicate the thermal conductivity is strongly affected by the ferromagnetic-paramagnetic transition, reported from specific heat measurements to be 69.3K. The results of the electrical resistivity of EUO gave values of about 3.5(10)9 ohm–cm at 61.5K and 1.4(10)9 ohm–cm at 297.2K. The resistivity decreases with increasing temperature as expected for a semiconductor. Author (TAB)

N68-10767 Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronenphysik.
ON THE LATTICE THEORY OF SOLID HELIUM AND OTHER VAN-DER-WAALS CRYSTALS OF LIGHT ATOMS [ZUR GITTERTHEORIE VON FESTEM HELIUM UND ANDERN VAN-DER-WAALS-KRISTALLEN AUS LEICHTEN ATOMEN]
Walter Biem Jul. 1967 64 p refs In GERMAN
(JUL-496-NP) CFSTI: $3.00

The lattice theory of light weight atoms and a hard core potential is used to develop an effective Hamiltonian operator for two atom interactions in a solid helium. Calculations on solid neon and solid hydrogen crystals require minimalization of free enthalpy and distance between equilibrium neighbors. Transl. by G.G.

N68-10800# Illinois Univ., Urbana. Dept. of Physics and Materials Research Lab.
THE EFFECT OF HIGH PRESSURE ON THE THERMOELECTRIC POWER AND RESISTANCE OF ALUMINUM AND GOLD
Ronald Ray Bourassa (Ph.D. Thesis) Jun. 1967 88 p refs
(Contract AT(11-1)-1198)
(COO-1198-465) CFSTI: HC $3.00/MF $0.65

The effect of pressure up to 4 kbar on the thermoelectric power of Al, Au, Ni, and Pt was determined. The change in resistance with pressure of Al and Au was also measured. Measurements were carried out at temperatures between room temperature and 1300°K or, in the case of Al, between room temperature and 900°K. A null method was used for resistance measurements and for thermoelectric power measurements, requiring an externally heated pressure vessel. The use of a special Mo alloy made this possible. High-temperature thermoelectric power data for Al are separated into terms associated with three thermally activated defects: the monovacancy, the divacancy, and the impurity–vacancy pair. Values for the formation energy and the volume were obtained for each of these defects. The effect of vacancies in gold is dominated by the effect of pressure on the lattice so that no quantitative results can be determined. An effect consistent with a monovacancy model is detected. Measurements in Pt and Ni were carried out to test the sensitivity of the method to changes in scattering mechanism. A phenomenological model is presented to explain the resistance data in Al and Au. This model gives the accepted formation volume of monovacancies in Au. It gives a value for the formation volume of monovacancies in Al in agreement with the value obtained from thermoelectric power measurements. The presence of divacancies in Al is strongly supported by this model. Author (NSA)

N68-10827# Delaware Univ., Newark. Dept. of Chemical Engineering.
DIFFUSION IN CRYSTALS Final Report, 1 Jan. 1964–31 Aug. 1967
31 Aug. 1967 89 p refs
(Contract AF 49(638)-1343)
(AFOSR-67-2289; AD-659492)

Results of research in the following fields are summarized: Surface self-diffusion; chemical interdiffusion, marker shift and chemical drift in alloys; diffusion in magnetic materials; diffusion of cations in solid solutions of Fe_2O_3-Cr_2O_3; cation ordering in the spinel ferrites $MgFe_2O_4$ and $NiFe_2O_4$. Drafts of manuscripts in preparation for publication are included in the appendices. TAB

N68-10854# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDY ON INFLUENCE OF FILM-FORMING SUBSTANCES ON ELECTROPHYSICAL PROPERTIES OF SURFACE OF GERMANIUM

V. A. Presnov and G. A. Katayev 18 Aug. 1967 18 p refs Transl. into ENGLISH from Poverkhn. i Kontaktn. Yavleniya v Poluprov. Sibirsk. Fiz.-Tekhn. Nauchn.-Issled. Inst. Pri Tomskom Gos. Univ. (Tomsk), 1964 p 47–58

(FTD-MT-66-91; AD-659311)

The influence of film-forming substances on magnitude and stability of surface potential, density, and energy position of levels of fast states was determined by nature of substances entering into composition of films. In connection with possibility of use of films of high-molecular substances for stabilization of semiconductor instruments, the influence of certain varnishes was studied and also of a series of components entering into various lacquers and enamels on electrophysical properties of surface of germanium.

Author (TAB)

N68-10883# Massachusetts Inst. of Tech., Cambridge.

MACROVORTICES AND TRANSIENT STABILITY IN HARD SUPERCONDUCTORS

Y. Iwasa, and J. E. C. Williams 22 Aug. 1967 15 p refs Presented at Cryog. Eng. Conf., Palo Alto, Calif.

(Contract AT(30-1)-3700)

(MIT-3700-5; E-4; CONF-670801-5) CFSTI: HC $3.00/MF $0.65

It has been found previously that under certain conditions and in the absence of transport current, a state of uniform magnetization in a hard superconducting wire can be used to change to a spatially periodic magnetization. During this change, the magnetization at discrete equally-spaced points along the wire collapses sequentially, generating a sequence of voltage pulses in any circuit inductively coupled with the wire. These effects are investigated using a short length of superconducting wire mounted in the end face of a phenolic tube. A pulse coil is located close to one point on the wire and a magneto-resistance probe is mounted on a rotating plate close to the surface of the wire. This entire assembly is placed in a mangetic field of about 10 to 20 kG to magnetize the wire. NSA

N68-10909 Technische Hochschule Hannover (West Germany).

MEASUREMENTS OF THE DIFFERENTIAL SORPTION TEMPERATURES AND ELECTRIC CONDUCTIVITY OF THE TITANIUM-HYDROGEN SYSTEM AS FUNCTIONS OF HYDROGEN CONCENTRATION [MESSUNGEN DER DIFFERENTIELLEN SORPTIONSWAERMEN UND DER ELEKTRISCHEN LEITFAEHIGKEIT IM SYSTEM TITAN-WASSERSTOFF IN ABHAENGIGKEIT VON DER WASSERSTOFF-KONZENTRATION]

Horst Strothenk (Ph.D. Thesis) 1965 108 p refs In GERMAN

Reported are calorimetric measurements of hydrogen adsorption on titanium films at 77°K and at 273°K. At 77°K, adsorption temperatures for a deposition of about 4×10^{14} molecules hydrogen/cm^2 were almost constant at 27.5 Kcal/Mol until they decreased and became immeasurable at 1×10^{15} molecules H_2/cm^2. Hydrogen sorption to titanium films at 273°K showed a pronounced dependency on concentration and caused structural changes in the titanium; pure surface effects could not be determined for differential adsorption temperatures.

Transl. by G.G.

N68-10916 Technische Hochschule Hannover (West Germany).

DETERMINATION OF PARAMAGNETIC TRACES IN DIAMAGNETIC SUBSTANCES BY SUSCEPTIBILITY MEASUREMENTS USING THE CYLINDER METHOD OF PLUECKER AND GOUY [UEBER DIE BESTIMMUNG PARAMAGNETISCHER SPUREN IN DIAMAGNETISCHEN SUBSTANZEN DURCH SUSZEPTIBILITAETSMESSUNGEN MIT DER ZYLINDERMETHODE VON PLUECKER UND GOUY]

Christoph Rutzen (Ph.D. Thesis) [1966] 105 p refs In GERMAN

An electronic balanced magnetic scale was used to measure quantitative traces of paramagnetic substances in lanthanum oxide. Spectral photometric measurements showed that this lanthanum oxide contained less than 5 ppm of cerium oxide, praseodymium oxide, and neodymium. Measurements with the magnetic scale on paramagnetic neodymium oxide traces in the lanthanum oxide gave 20 ppm Nd_2O_3 at a statistical verification of 99.7%. It is shown that a purity determination of 99.996% La_2O_3 is feasible.

Transl. by G.G.

N68-10932*# Radio Corp. of America, Princeton, N. J.

VAPOR PHASE GROWTH TECHNIQUE AND SYSTEM FOR SEVERAL III-V COMPOUND SEMICONDUCTORS Quarterly Technical Report

J. J. Tietjen, R. Clough, and D. Richman Jun. 1967 16 p refs

(Contract NAS12-538)

(NASA-CR-90110; QTR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The objective of this contract is a single vapor phase growth system to prepare GaP, GaAs, InSb, InP, InAs, InSb, and selected alloys of these compounds. In addition, the system should provide for n- and p-type doping and the preparation of multilayer structures. An RCA method used to prepare GaAs, GaP, and their alloys is being extended for the growth of compounds and alloys containing In and Sb. The work is progressing satisfactorily. Three separate vapor growth systems have already been put into operation to facilitate the research. The growth parameters for InAs and InP were investigated, and adequate growth rates for single-crystalline layers were achieved. In addition, an $In_1Ga_{.9}As$ alloy single-crystal layer has been prepared in a system in which, for the first time, the In and Ga sources were maintained at different temperatures. InAs has also been prepared as both n- and p-type layers; initial characterization shows it to be of high quality. Because stibine has not yet been available, an alternate method such as chloride transport of Sb metal may be selected.

Author

N68-10956* Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF ELECTRON EMISSION, CONDUCTIVITY AND LUMINESCENCE OF SELECTED SOLIDS UNDER VACUUM UV RADIATION Status Report No. 10, May 1–Oct. 31, 1967

William Pong and K. Watanabe 31 Oct. 1967 7 p

(Grant NsG-328)

(NASA-CR-90062) CSCL 20L

Photoemission measurements as a function of film thickness were made to determine the attenuation length of excited electrons in metallic films of gold and aluminum. Based on the findings, it is assumed that the electron–electron mean free path in aluminum is about four times as large as that in gold. For photoelectric yield measurements, a clean ultrahigh vacuum chamber with a movable termopile detector mounted at the exit slit of a vacuum monochromator was constructed.

M.G.J.

N68-10962# Hughes Research Labs., Malibu, Calif.
ELECTRON REFLECTION COEFFICIENT AT ZERO ENERGY II: COMPUTER EXPERIMENTS ON THE REFLECTION OF SLOW ELECTRONS IN THE ELECTROSTATIC FIELD OF SURFACE PATCHES
H. Heil Jun. 1967 34 p refs
(Contract AF 19(628)-4297)
(AFCRL-67-0378; SR-4; AD-659136)

As reported in AD-652 223, the zero energy reflection coefficient of electrons at a polycrystalline silver surface has been measured to be about 7%. A theory consistent with this experimental result is now presented. This theory shows that the zero energy reflection coefficient may be fully explained by the effect of patches of different work functions. The reflection coefficient was found to be independent of patch size and patch potential amplitude and is about 7.73% for the stripe-type and about 5.4% for the square-checkerboard-type patches. The reflection coefficient jumps abruptly from 100% below the threshold of energy to some 6% at an energy immediately above threshold; therefore, it is not surprising that recent energy analyses with a simple patch counterfield electrode of several hundred millivolt patch amplitude can resolve fine structure in the energy of less than 10 meV as exhibited in the energy spectrum of electrons field-emitted from a liquid-helium-cooled tip. TAB

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-10046* United Technology Center, Sunnyvale, Calif.
A STOP-START STUDY OF SOLID PROPELLANTS Final Technical Report, 13 Sep. 1966–13 Nov. 1967
G. E. Jensen Nov. 1967 102 p refs
(Contract NAS1-6601)
(NASA-CR-66488; UTC-2243-FR) CSCL 21I

Rapid-depressurization (P) and critical chamber geometry (L) extinction characteristics of a series of composite propellants were investigated using a windowed end-burning grain motor for P and L extinguishment tests and a slab motor for P tests. Systematic variation in the binder, binder curing agent, catalyst type and concentration, oxidizer concentration, and aluminum loading level were studied to elucidate the mechanisms of composite propellant combustion extinguishment. Author

N68-10099* Technidyne, Inc., West Chester, Pa.
GELLING OF LIQUID HYDROGEN Final Report
C. Dana McKinney and William B. Tarpley 1 Jun. 1966 90 p refs Prepared jointly with Marquardt Corp.
(Contract NAS3-4186)
(NASA-CR-54967; RR-66-49) CSCL 21I

The high energy, low density solid fuels lithium and lithium borohydride were prepared by several methods in the ultrafine particles required for gelling liquid hydrogen. Lithium-gelled liquid hydrogen at 61.1 w/o (17.4 v/o), and 58.8 w/o (13.3 v/o) of lithium borohydride produced a liquid hydrogen gel. Scale up of liquid hydrogen preparation from 0.5 to 2.2 liter quantities posed no serious problems. Gelled liquid hydrogen was cold-flowed through test components with negligible restrictions due to gellant deposition under normal operating conditions. Liquid hydrogen gels based on lithium were stable to moderate levels of shock and vibrational acceleration. Heat introduced into a hydrogen-silica gel caused a predictable increase in evaporation rate without visible boiling. Gelling reduced the rate of evaporation by a factor of 2–3, thus improving storability. A non-cryogenic simulant gel was pumped without undue difficulty. Author

N68-10995* Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
AN EXPERIMENTAL INVESTIGATION OF THE GASEOUS PHASE REACTION ZONE IN A COMPOSITE SOLID PROPELLANT
R. L. Derr and J. R. Osborn Sep. 1967 125 p refs
(Grant NsG-592)
(NASA-CR-90226; JPC-438; TM-67-6) CSCL 21I

This report discusses an experimental investigation of the gaseous reaction zone located above the burning surface of a composite solid propellant. In the investigation, the temperature profile within the gaseous reaction zone was measured with a modified line reversal pyrometer. In conjunction with this, a servo-controlled feedshaft was employed to drive the strand of propellant toward the temperature measurement region at the same rate at which the strand burned. This technique enabled a zone in the flame to be examined over a controlled length of time. A polysulfide–ammonium perchlorate solid propellant was used in the study. The effect of oxidizer size on the temperature profile was investigated by using a propellant containing a fine oxidizer grind and a propellant containing a coarse oxidizer grind. The propellants were burned at pressures ranging from atmospheric to 215 psia. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-10178* International Information, Inc., Philadelphia, Pa.
INVESTIGATION OF COMPRESSED GAS DISPERSION IN RELATION TO ITS APPLICABILITY IN GAS TURBINE ENGINES
H. Gehrig (Ph.D. Thesis—Darmstadt Tech. Coll.) Washington NASA Mar. 1967 98 p refs Transl. into ENGLISH of the publ. "Untersuchung der Druckgaszer-Staeubung im Hinblick auf Ihre Anwendbarkeit in Gasturbinen-Triebwerken" West Ger., Darmstadt Tech. Hochschule, 1965 102 p
(Contract NASw-1499)
(NASA-TT-F-10718) CSCL 21E

On the basis of a systematic evaluation of a number of nozzle characteristics, an attempt is made to determine the extent to which general diagrams may be derived for all nozzle types in order to arrive at a conclusion concerning jet impulse and its components. Parameters characterizing attainable penetration depths are established. A comparative evaluation of the contour diagrams and nozzle parameters provides basic relationships significant for the design of the combustion chamber and selection of the nozzle type. Guidelines for flameholder configurations and nozzle arrangements, and for flameholders in the main and afterburning chambers are obtained by introducing various flameholders into or in

front of the hot jets. The determinations are preferably conducted in the cold state at first and later in the high-temperature state in order to establish any deviations. In the high-temperature tests, the main combustion chamber is considered with special emphasis on the determination of preparation and combustion lengths. The effect of the mass ratio between atomization air and fuel on the ignition boundaries and on burnout are investigated, and the most suitable operating conditions are established. Author

N68-10208* Boeing Co., Seattle, Wash.
BURNER II HYBRID PROPULSION STUDY
31 Aug. 1967 66 p refs
(Contract NAS1-7485)
(NASA-CR-64475; D2-113384-2) CSCL 21H

The performance and configuration characteristics of hybrid propulsion systems versions of the Burner II stage are described. Data is presented for both synchronous orbit and high velocity probe missions on the Atlas/Centaur/Burner II launch vehicle. Configuration effects are evaluated for both an optimized rocket motor and for a stage with minimum changes to the existing Burner II. Author

N68-10496*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THERMAL INVESTIGATION OF AN ION ENGINE MICRO-THRUSTOR
N. J. Stevens and D. C. Briehl Washington Nov. 1967 15 p refs
(NASA-TM-X-1473) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A cesium contact-ion microthrustor that was designed at the Lewis Research Center was studied to determine the heat transfer conditions necessary to minimize the heater power. The micro-thrustor was simulated on a resistance analog network which was balanced to an experimentally obtained set of temperatures and power inputs from a full-size thermal model test. No cesium was used in the thermal model. The major thermal losses were identified as conduction through the tank mounts and radiation from the hot feed tube insulation, accelerator, and cesium tank. The thermal model with these losses minimized was predicted to operate at 13.1 watts, and actually it operated at 12.9 watts. Application of modifications to the actual thrustor reduced the power requirements by the expected 13 percent. Author

N68-10502*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EFFECTS OF AXIAL GRADIENTS OF VELOCITY AND MAGNETIC FIELD, ELECTRODE STAGGER, AND ION SLIP ON PARAMETERS IN MHD ACCELERATORS
Frank Hohl Washington NASA Nov. 1967 40 p refs
(NASA-TN-D-4239) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The distributions of current and potential have been determined for two linear Faraday plasma accelerators. The equations describing the electrical parameters of accelerators were reduced to two dimensions and numerical analysis was used to solve the equations. The internal resistance of the accelerator, the Hall potential gradient, and various other parameters have been calculated as functions of: velocity and magnetic field gradients along the channel axis, ion slip, various amounts of stagger of electrodes, the ratio of electrode width to insulator width, and the Hall parameter. The results are compared with previous theoretical work and with experimentally obtained data. Author

N68-10562*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PERFORMANCE TESTS OF A 1/2-MILLIPOUND (2.2 mN) AMMONIA RESISTOJET THRUSTOR SYSTEM
Harold Ferguson and James S. Sovey Washington Nov. 1967 19 p refs
(NASA-TN-D-4249) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Performance data were obtained and evaluated for a nominal 1/2-millipound-(2.2 mN) thrust resistojet system, with ammonia as the propellant. The system is defined to include the thrustors, the propellant storage and feed components, and the power and signal conditioning module. For a nominal system input power of 8 watts, the valves and power conditioning required 3 watts. The power delivered to the thrustor was 5 watts, of which approximately 1 watt represented augmented thrust power. For these conditions, a specific impulse of 140 seconds was obtained. The system was capable of maintaining specified thrust tolerances for either liquid or vapor propellant extraction and thus should be able to operate in a zero-gravity environment. Author

N68-10633*# United Aircraft Corp., East Hartford, Conn. Research Labs.
ANALYTICAL STUDY OF CATALYTIC REACTORS FOR HYDRAZINE DECOMPOSITION Annual Progress Report, 15 Apr. 1966–14 Apr. 1967
Arthur S. Kesten May 1967 89 p refs
(Contract NAS7-458)
(NASA-CR-89791; UACRL-F910461-12; APR-1) CFSTI: $3.00 CSCL 21H

An analytical study of catalyzed hydrazine decomposition reaction chambers was performed in order to establish procedures capable of predicting the steady-state and transient behavior of the system. The study included the development of computer programs to calculate the temperature and reactant concentration distribution as functions of time and axial position in typical reaction chamber configurations. The computer programs evolved are based upon models of the reactor system which consider both thermal and catalytic decomposition of reactants, along with simultaneous heat and mass transfer between the free-gas phase and the gas within the pores of the catalyst pellets. Results obtained using these computer programs are in excellent agreement with data available from small scale engine firings using Shell 405 catalyst thus permitting not only correlation of the test data but also indirect determination of hydrazine and ammonia decomposition kinetics on 405 catalyst. Author

N68-10686*# Field Emission Corp., McMinnville, Oreg.
BEHAVIOR OF VARIOUS ADSORBATES ON METAL SUBSTRATES Final Report, 23 Dec. 1965–17 Feb. 1967
C. J. Bennette, R. W. Strayer, L. W. Swanson, and E. C. Cooper 25 Apr. 1967 130 p refs
(Contract NAS3-8900)
(NASA-CR-72117) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Field emission and retarding potential techniques were applied to certain physical phenomena occurring on bombardment thruster electrodes and cathode surfaces, so that an improved design of the thruster could be obtained. Efforts were focused on three areas: (a) field emission and retarding potential studies of the work function changes and surface kinetics of cesium and oxygen adsorbates on selected nonrefractory metals, and of the activation poisoning and sputtering phenomena for oxide cathodes; (b) field ion and field emission microscope investigations of noble gas and cesium ion sputtering of refractory metals; and (c) field emission studies of the interaction of low energy electrons with cesium or mercury adsorbates on clean and oxygen-covered tungsten. The

field ion and field emission microscope studies of sputtering were conducted for helium ion bombardment of tungsten and iridium and cesium ion bombardment of tungsten. S.P.

N68-10929 National Aerospace Lab., Tokyo (Japan).
THE AERODYNAMIC PERFORMANCE OF A SINGLE-STAGE AXIAL-FLOW COMPRESSOR WITH DOUBLE CIRCULAR-ARC BLADES
Shoichi Fujii, Hideo Nishiwaki, Akira Yoshida, Mitsuo Gomi, Katsumi Takeda et al May 1967 31 p refs In JAPANESE; ENGLISH summary
(NAL-TR-134)

A specific compressor was designed similarly to the blade-shapes used in the third rotor wheel and stator vane of a 5-stage transonic compressor for modern jet-engine. Then, there were two distinct objectives in this study: one was to obtain further information on the internal flow of transonic regime, the other to know locally the aerodynamic performance of the above-mentioned 5-stage compressor. Detailed survey data and analyses are presented. A misleading combination of guidevane, rotor, and stator operating at high subsonic or transonic Mach numbers has turned out to be a compressor of lower efficiency than would have been expected. However, the fair agreement of turning angles between the estimated and the actual measured values is encouraging. Author

N68-10942# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
FLOW VISUALIZATION OF A 1/10 SCALE LM ASCENT ENGINE PLUME DURING LUNAR LIFT-OFF
J. Leng and A. R. Johnson Oct. 1967 15 p refs Presented at the 28th Semi-Ann. Meeting of the Supersonic Tunnel Assoc., Denver, 30 Oct.–1 Nov. 1967
(RM-381J)

Shock tunnel experiments were conducted of a 1/10 scale simulation of the lunar module (LM) ascent engine firing on top of the descent stage during lunar lift-off. Heat transfer rates and pressure distributions on top of the descent stage and on the bottom of the ascent stage were measured. Self-luminosity photographs were taken of the flow fields generated at various stage separation distances. Presented in this paper are some of these photographs as well as enlargements of several consecutive frames from high-speed motion picture sequences that show the flow field starting transients, the duration of steady flow, and the unsteady flow, after-flow coming from the detonation tube. These sequences, in conjunction with the detonation tube stagnation pressure and free stream stagnation point heat transfer records, help establish the validity of the technique. K.W.

N68-10986*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DEVELOPMENT AND DEMONSTRATION OF CRITERIA FOR LIQUID FLUORINE FEED SYSTEM COMPONENTS Final Report
Oct. 1967 493 p refs
(Contract NASw-1351)
(NASA-CR-72063; DAC-60599) CFSTI: HC $3.00/MF $0.65
CSCL 21H

A study was conducted to (1) establish criteria for use in the design, fabrication, inspection, and servicing of fluorine flight-weight propellant feed systems, and (2) demonstrate, where necessary, the adequacy of these criteria. Consideration is given to a literature search and formulation of preliminary criteria, feed system analysis, subcomponent tests, design evaluations, component demonstration tests, and safety and health. It is concluded that designs of feed systems for fluorine service are unique from other high energy oxidizers in the areas of material compatibility and the degree of system cleanliness required. Except for these two items, LO_2 and LF_2 systems are similar. C.T.C.

N68-10971* Air Products and Chemicals, Inc., Allentown, Pa. Cape Kennedy Engineering Dept.
STATIC AND DYNAMIC ANALYSIS OF THE CRYOGENIC PROPELLANT LOADING SYSTEM. VOLUME I
20 Apr. 1966 71 p refs
(Contract NAS10-939)
(NASA-CR-90212) CSCL 21H

This report describes a complete investigation into the structural integrity of the cryogenic propellants loading systems at Launch Complex 39. The objectives were to define the maximum stresses which could be expected within the three cryogenic fill lines, the three cryogenic vent lines, and the related pipe supports and anchors, and to recommend appropriate modifications. The scope included the stresses caused both by static loading such as thermal shock, internal pressure, or bending moments, and by dynamic loading such as pressure surges, periodic pressure perturbations, or structural vibrations. Problems are resolved by either design recommendations to increase strength, or control procedure recommendations to reduce loading. In many instances, the detailed analysis of a member merely confirmed the integrity of the original design, and led to no recommended modification. Author

N68-10994 Lockheed Missiles and Space Co., Palo Alto, Calif.
LIMITING DEVIATIONS AND SCATTER IN THE BALLISTIC PARAMETERS OF A SOLID FUEL ROCKET ENGINE (RDTT)
R. E. Sorkin [1967] 22 p ref Transl. into ENGLISH from the book "Gas-Thermodynamics of Solid Fuel Rocket Engines" Moscow, Nauka FML Press, Chapter XV, 1967 p 295–325

Equations are derived for analysis of the ballistic parameters of a solid fuel rocket engine based on the following considerations: (1) variations of the ballistic engine parameters, (2) scatter in ballistic parameters in the unregulated nozzle case, (3) total limiting deviations in the unregulated nozzle case, (4) limiting deviations and scatter of engine parameters in the regulated nozzle case, (5) scatter in the pressure and thrust in the case of multinozzle engine construction, (6) scatter in ballistic parameters at thrust cut-off, and (7) and general methods of computing the scatter of ballistic engine parameters. E.C.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-10035 Imperial Coll. of Science and Technology, London (England). Dept. of Physics.
THE COMPATIBILITY OF VARIOUS INTERPLANETARY FIELD MODELS WITH COSMIC RAY MODULATION DATA
J. J. Quenby Jun. 1966 36 p refs

Convective diffusion models for the motion of cosmic rays in the interplanetary, electromagnetic field are presented for both isotropic and anisotropic diffusion situations. Measurements of the

long-term modulation, including recent high-altitude data obtained in 1965, fit the following simple model. Spherical symmetry is assumed for the solar cavity with the boundary at 50 A.U. In the solar equatorial plane, the magnetic field follows the archimedian spiral predicted by Parker with superimposed scattering centres. The particle mean free path, λ is proportional to r^2 where r is the distance from the sun. A modulation theory based on energy loss alone in a scalar electric potential field, even when the path traversed is rigidity dependent, does not explain the experimental observations. Author

N68-10063 Science Council of Japan, Tokyo.
COSMIC-RAY INTENSITY DURING THE INTERNATIONAL YEARS OF THE QUIET SUN NUMBER 10. NEUTRON INTENSITIES IN 1964, STATIONS A TO H
Mar. 1967 200 p

Neutron component data are listed in the form of natural logarithms of the counting rates in units of 0.1% corrected for the barometer effect. The logarithmic representation for the conversion method is explained. Monthly tables are composed of hourly or bihourly values, and the daily sum and average are listed for convenience in inspecting the day-to-day variations. To more easily see the average shape of the daily variations, the monthly means of hourly or bihourly values are given. These means are calculated from data in completed days, i.e., the days without lack of observations are further analyzed to obtain the first and second term of harmonic components. Author

N68-10067* State Univ. of Iowa, Iowa City.
SATELLITE OBSERVATIONS OF VLF EMISSIONS AND THEIR ASSOCIATION WITH ENERGETIC CHARGED PARTICLES
Donald A. Gurnett Sep. 1967 31 p refs
(Grant NGR-16-001-043; Contract Nonr-1509(08))
(NASA-CR-89967; Rept.-67-53) CSCL 04A

A summary of recent satellite observations of VLF emissions and their association with energetic charged particles is presented. Using data from the Injun 3 satellite maps of the broadband intensity of magnetospheric VLF emissions are shown as a function of invariant latitude and magnetic local time. Examples of the simultaneous occurrence of VLF emissions and energetic charged particle precipitation are discussed. Author

N68-10084* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPLORER XII OBSERVATIONS OF SOLAR COSMIC RAYS AND ENERGETIC STORM PARTICLES FOLLOWING THE SOLAR FLARE OF 28 SEPTEMBER 1961
D. A. Bryant, T. L. Cline, U. D. Desai, and F. B. McDonald Jul. 1962 53 p Submitted for publication
(NASA-TM-X-55963; X-611-62-126) CFSTI: $3.00 CSCL 20H

A full description of the cosmic ray experiment on Explorer XII is given and cosmic ray measurements made during the solar solar event of 28 September 1961 are reported and discussed. Galactic cosmic ray measurements are also reported. Author

N68-10352# Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.
RESEARCHES IN THE FIELD OF SOLAR RADIO NOISE AS WELL AS OPTICAL SUNSPOT PHENOMENA Final Scientific Report, 1 Jan. 1964–1 Feb. 1967
Eberhart Jensen 15 Apr. 1967 35 p refs
(Contract AF 61(052)-743)
(AFCRL-67-0508; AD-659380)

The researches cover the general field of solar radio noise and optical sunspot phenomena. Special attention has been devoted to the following items: Secular variations in solar activity, instrumental influences on spectral lines, fine structure in spectral lines, sunspot models, long term variations in radio noise, impulsive radio phenomena and propagation of electromagnetic waves. The work has been reported in several research papers which are all listed in this report. TAB

N68-10358*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RESPONSE OF THE UPPER ATMOSPHERIC TEMPERATURE TO CHANGES IN SOLAR EUV RADIATION AND GEOMAGNETIC ACTIVITY
S. Chandra and B. V. Krishnamurthy Aug. 1967 22 p refs Presented at the 8th COSPAR Intern. Space Sci. Symp., London, Jul. 1967
(NASA-TM-X-63014; X-615-67-385) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The upper atmospheric neutral temperature derived from satellite drag is analyzed with a view to determine the relative importance of solar EUV and magnetic activity on heating of the upper atmosphere. As the indices of solar EUV radiation, the radio fluxes obtained from the ground based observations in the frequency range of 200–9400 Mc/s are used. Also for the period March 7–May 15, 1962, a direct comparison is made with the EUV flux obtained from the OSO 1 Satellite. As the index of magnetic activity the planetary magnetic index K_p is used. Author

N68-10375*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPOSITION OF THE 2ND SEPTEMBER 1966 SOLAR PARTICLE EVENT
N. Durgaprasad, C. E. Fichtel, D. E. Guss, and D. V. Reames Jul. 1967 13 p refs
(NASA-TM-X-63012; X-611-67-324) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Three Nike–Apache sounding rockets were launched from Manitoba, Canada to study the composition and the characteristics of the September 2, 1966 solar flare event. These launches occurred approximately 9, 16, and 36 hours following the event. Nuclear emulsions were used to study all the components, namely, the singly, doubly, and multiply charged nuclei emitted in the solar event and propagated within the solar system. The helium nuclei were separated from protons by using grain density and range measurements and from multiply charged nuclei by δ-ray density and range measurements. The multiply charged nuclei were charge identified from δ-ray density and range measurements. The energies of these nuclei were mainly determined from their residual range in the emulsion. The energy spectra measured in the event are much steeper than those reported for events in which the composition studies were made previously. The measured ratio of helium to medium (C, N, O, F) nuclei for energies above 12.7 MeV/nucleon in the first flight is 54 ± 8. This value is in agreement with the previous measurements and this strongly supports the ideas held that the acceleration mechanism does not appreciably alter the spectroscopically observed abundance of the solar photosphere. Author

N68-10426 Pennsylvania State Univ., University Park. Radio Astronomy Observatory.
SOLAR RADIO FLUX OBSERVED AT UNIVERSITY PARK, PENNSYLVANIA, JANUARY–FEBRUARY–MARCH 1967

John P. Hagen Oct. 1967 59 p
(Grant NSF GA-720)
(SR-009) CFSTI: $3.00

This report contains solar radio flux data recorded at 10700 Mc/s, 2700 Mc/s, and 960 Mc/s during the quarter 1 January 1967 to 31 March 1967. A table of distinct events is also given. Author

N68-10486# Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies.
COSMIC RAY DETECTION BY ATMOSPHERIC FLUORESCENCE
Alan Newton Bunner (Ph.D. Thesis) Feb. 1967 204 p refs
(Contract AT(30-1)-3038)
(NYO-3038-5) CFSTI: HC $3.00/MF $0.65

The purpose of this thesis is to discuss the technique of using the atmosphere as a scintillator for the study of very high-energy cosmic particles. NSA

N68-10507*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENT AND INTERPRETATION OF THE ISOTOPIC COMPOSITION OF HYDROGEN AND HELIUM COSMIC RAY NUCLEI BELOW 75 MeV/NUCLEON
J. P. Meyer, Donald E. Hagge, and Frank B. Mc Donald Aug. 1967 18 p refs Presented at the 10th Intern. Conf. on Cosmic Rays, Calgary, Canada, Jun. 1967
(NASA-TM-X-63015; X-611-67-401) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Measurements of the hydrogen ($\Gamma_d \approx d/H^1$) and helium ($\Gamma_{He} \approx He^3/He^4$) isotopic abundance ratios were made by the IMP-III and OGO-I satellites outside the earth's atmosphere and magnetosphere. The results show a very steep positive slope for Γ_d between 20 and 50 MeV/n; Γ_{He} has a positive slope between 30 and 90 MeV/n. Propagation calculations were undertaken to study the bearing of different source and propagation models on Γ_{He} and on Γ_d which is not affected by the solar modulation. A Monte Carlo technique was used to propagate the cosmic ray protons and He^4 nuclei from the source to the earth. Available cross section data were surveyed. Ionization loss, energy dependence of the cross sections, and reaction kinematics were considered. The results are considered to completely rule out a total energy, and favor a kinetic energy source power spectrum. M.G.J.

N68-10509*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EARLY EFFECTS OF INCREASING SOLAR ACTIVITY UPON THE TEMPERATURE AND DENSITY OF THE 1000 KILOMETER IONOSPHERE
L. H. Brace, H. G. Mayr, and B. M. Reddy Sep. 1967 26 p refs
(NASA-TM-X-63019; X-621-67-478) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Observations of electron temperature and concentration at 1000 km were carried out by electrostatic probes on Explorer XXII. Midday and midnight measurements at latitudes of approximately 60°N to 60°S for January 1965, 1966 and 1967 are presented. Comparison of these latitude profiles shows that the day-time electron density at 1000 km increases with solar activity while the electron temperature increases initially but then decreases. The nighttime ionosphere is less affected by the increased solar activity, although N_e decreases somewhat and T_e increases slightly. This behavior can be understood qualitatively in terms of the changing composition and density of the neutral atmosphere, caused by the increase in neutral temperature during increasing solar activity. Of prime importance for the electron temperature is the early escape of neutral hydrogen which reduces the effective local cooling of electrons and permits T_e to rise initially. The higher gas temperatures associated with increased solar activity cause enhancement of the heavier neutral constituents (O, He) which increases the local electron cooling and results in lower electron temperatures. Author

N68-10563*# California Univ., Berkeley. Space Sciences Lab.
SOLAR AND INTERPLANETARY MAGNETIC FIELDS AND PLASMAS
John M. Wilcox 20 Sep. 1967 25 p refs Presented at the 13th Gen. Assembly, Intern. Astronomical Union, Prague, Aug. 1967 /ts Ser. No. 8, Issue No. 70
(Grant NsG-243; Contract Nonr-3656(26))
(NASA-CR-90246; AD-659495) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A few recent observations of interplanetary fields and plasmas are discussed, including the evolution over several years of the longitudinal sector pattern, the corotating filamentary structure that exists within the sectors, guiding of solar cosmic rays along such magnetic filaments, a field-aligned thermal anisotropy of the plasma, and a small component of corotating plasma velocity observed at 1 A.U. The solar wind plasma streaming past spacecraft near 1 A.U. contains a large amount of information about the detailed structure of the sun. Author (TAB)

N68-10672 Pennsylvania State Univ., University Park. Radio Astronomy Observatory.
SOLAR RADIO FLUX OBSERVED AT UNIVERSITY PARK, PENNSYLVANIA, APRIL–MAY–JUNE 1967
John P. Hagen Oct. 1967 50 p
(Grant NSF GA-720)
(SR-010)

Tabulations are presented on solar radio flux data recorded at 10700 Mc/s, 2700 Mc/s, and 960 Mc/s. An unweighted average of the available hourly flux values is given for each three-hour period, together with daily averages of the available hourly flux values. The unit of flux density used is 10^{-22} Wm^{-2} $(c/s)^{-1}$; the values given refer to both polarizations. Tables of distinct events are also included. M.G.J.

N68-10685# Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.
THE LIFETIME OF H α-STRUCTURES IN ACTIVE REGIONS OF THE SUN
Odd Gimse 1967 19 p refs Reprint of Rept.-21
(Contract AF 61(052)-743)
(AFCRL-67-0481; Rept.-21; SR-15; AD-659150)

During the last two quarters of 1966 time series of exposures of active regions on the sun were obtained at the Solar Observatory at Harestua using the Zeiss Coude refractor and a Lyot monochromator. By a graphic method the mean lifetime of 574 fibrills taken from 81 selected areas is found to be 4 hours. Author (TAB)

N68-10727 National Physical Lab., New Delhi (India). Radio Science Div.
DAYTIME ION COMPOSITION IN THE HEIGHT RANGE OF 150–1500 KM FOR SOLAR MINIMUM CONDITION

V. P. Bhatnagar 1 Aug. 1967 40 p refs
(RSD-535; SR-35) CFSTI: HC $3.00

The ion composition model is based on a neutral atmospheric model, solar flux data, and the electron and ion temperatures close to minimum solar activity period. The topside ionosphere has been assumed to be a ternary mixture of atomic oxygen, helium, and atomic hydrogen ions. The calculated distribution of O^+ agrees with that observed, if the rate coefficients γ_1 and γ_2 for the charge exchange between O^+ and N_2, and O^+ and O_2 have values of about $1\times10^{-12}cm^3/s$ and $1\times10^{-11}cm^3/s$ respectively, at F-region temperatures. In the case of helium ions a reasonable agreement between the calculated and observed values is obtained, if the rate coefficients k_1 and k_2 for the charge exchange between He^+ and N_2, and He^+ and O_2 have values of about $10^{-11}cm^3/s$. In the case of atomic hydrogen ions, agreement between the calculated and observed values is obtained, if the neutral atomic hydrogen distribution is increased by a factor of about 5. Author

N68-10852# Oak Ridge National Lab., Tenn.
THE MANY-PARTICLE MECHANISM OF INTERACTION OF COSMIC RAYS WITH ATOMIC NUCLEI [MNOGOCHASTICHNYI MEKHANIZM VZAIMODEISTVIYA KOSMICHESKOGO IZLUCHENIYA S ATOMNYMI YADRAMI]
I. Z. Artykov, and V. S. Barashenkov, and S. M. Eliseev [1968] 7 p refs Transl. into ENGLISH from Russian
(ORNL-TR-1716; JINR-P2-3005)

Interactions of nucleons with photoemulsion nuclei are calculated for the energies of 6 to 1000 GeV. Many-particle cascade interactions inside the nuclei are taken into account. The results of calculations are compared with the experimental data. Author (NSA)

N68-10895 Lockheed Missiles and Space Co., Sunnyvale, Calif.
"COSMOS-166" ON SOLAR PATROL
S. Mandel'shtam, V. Mikhailov, and Iu. Zaitsev 1967 5 p Transl. into ENGLISH from Pravda (Moscow), no. 275 (17957), 2 Oct. 1967 p 3

Mission objectives for the Soviet satellite Cosmos-166, launched on 16 July 1967, are described in a news release. The satellite collected data on solar atmospheric phenomena, particularly solar flare activity. Satellite instrumentation is reported and preliminary results of post-mission data analysis are mentioned. E.C.

N68-11005*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
PROTONS ASSOCIATED WITH CENTERS OF SOLAR ACTIVITY AND THEIR PROPAGATION IN INTERPLANETARY MAGNETIC FIELD REGIONS CO-ROTATING WITH THE SUN
C. Y. Fan, M. Pick, R. Pyle, J. A. Simpson, and D. R. Smith Aug. 1967 67 p refs
(Contract NAS2-3876; Grant NsG-179-61; Contract AF 39(638)-1642)
(NASA-CR-90227; EFINS-67-72) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The Pioneer-6 and Pioneer-7 space probes carried charged-particle telescopes which measure, for the first time, both the direction of arrival and differential energy spectra of protons and alpha particles. The intensity changes, directional distributions, and energy spectra of proton fluxes associated with solar activity are investigated. The data were obtained in the beginning of the new solar cycle (No. 20), when it is possible to unambiguously associate proton flux increases with specific solar active regions. The origin, possible long-term storage, and propagation of these proton fluxes are investigated. It was observed that enhanced 0.6–13 MeV proton fluxes associated with specific active regions were present over heliographic longitude ranges as great as ≈180 degrees. These enhanced fluxes exhibit definite onsets and cut-offs which appear to be associated with the magnetic sector boundaries observed by Ness on Pioneer-6. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-10002*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
DIRECTIONAL CHARACTERISTICS OF LUNAR THERMAL EMISSION
C. G. Montgomery, J. M. Saari (Boeing Sci. Res. Labs.), R. W. Shorthill (Boeing Sci. Res. Labs.), and N. F. Six, Jr. Nov. 1966 102 p refs Prepared in cooperation with Boeing Sci. Res. Labs.
(Contract NAS8-20166)
(NASA-CR-89980; D1-82-0568; R-213) CSCL 03B

Preliminary studies of the directional characteristics of lunar thermal emission have been completed using existing infrared lunation data. Brightness temperatures were obtained at every 10° interval of a thermal latitude and longitude grid system where the subsolar point was defined as the thermal north pole, the antisolar point as the thermal south pole, and the thermal prime meridian as passing through the apparent disk center. The results are presented in the form of a family of plots for: (1) brightness temperature versus thermal longitude at constant phase for different thermal latitudes; (2) brightness temperature versus thermal longitude at constant thermal latitude for different phases; and (3) brightness temperature versus phase at constant latitude for different thermal longitudes. Author

N68-10003*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DECAMETER WAVELENGTH OBSERVATIONS OF JUPITER, OCTOBER, 1966–MARCH, 1967
J. K. Alexander Oct. 1967 33 p refs
(NASA-TM-X-55996; X-615-67-531) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Decametric observations of Jupiter obtained at Goddard Space Flight Center and Carnarvon, Australia, during the 1967 apparition are summarized and discussed. From analysis of 563 hours of observations at 16.7 MHz and 682 hours of observations at 22.2 MHz, the over-all probability of occurrence of activity was found to increase at 16.7 MHz but decrease at 22.2 MHz when compared to results from the previous apparition. There is evidence for a relative increase in the probability of occurrence of Io-controlled emission at both frequencies, however. Examination of the long term variation of the system III longitude and occurrence probability of the main emission region shows the data to be consistent with the hypothesis that there is a quasi-cyclic variation in the occurrence probability statistics and apparent rotation rate although such an effect is still not fully understood. Analysis of of the intensities of storms as a function of μ III suggests that activity from the Io-controlled B source is consistently more intense than activity from other regions. A catalogue of the observations is included in an appendix. Author

N68-10005*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICRO-SCALE STRUCTURES IN THE INTERPLANETARY MEDIUM
Leonard F. Burlaga Sep. 1967 55 p refs
(NASA-TM-X-55995; X-612-67-524) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Described and analyzed are the following micro-scale (≤.01 AU) structures which were found in combined interplanetary magnetic field and plasma data obtained by the deep space probe, Pioneer 6: (1) Several types of simultaneous discontinuities in the magnetic field and plasma parameters; (2) at least one clear example of a transitional region (D-sheet) associated with a plasma discontinuity; (3) other D-sheets which give evidence of magnetic field annihilation; (4) inhomogeneous isothermal regions in which the square of the magnetic field intensity is proportional to the density; and (5) periodic variations in the magnetic field intensity which are associated with discontinuities in the bulk speed. It is suggested that small velocity discontinuities play a fundamental role in reducing stresses in the interplanetary medium, and that large velocity discontinuities may give rise to waves and turbulence. Author

N68-10029*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
GRAVITY GRADIENTS ON THE EARTH'S SURFACE AS DEDUCED FROM SATELLITE ORBITS
Walter J. Koehnlein 25 Aug. 1967 22 p refs
(Grant NsG-87-60)
(NASA-CR-89973; SAO Special Rept.-249) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The variation of gravity on the earth's surface is computed in mutually perpendicular directions: the horizontal anomalous variations along the geocentric latitude and longitude curves, and the vertical component along the plumb line. The numerical results obtained from Kozai's and Gaposchkin's latest harmonic coefficients indicate a correlation between the anomalous vertical gravity gradient and the earth's continental topography. Author

N68-10070* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EARLY ORBIT AND ATTITUDE DETERMINATION PLAN AND PRELAUNCH ANALYSIS FOR THE SATELLITE TOS-B
Jan. 1967 49 p
(NASA-TM-X-63002; X-547-67-24) CSCL 03B

Prelaunch plans, schedules, mission and orbital specifications, and ground support operations are presented. The attitude specifications and determination are covered, and the expected percent sunlight, solar illumination, and picture coverage are described. It was determined that the launch window would occur between 9:00 am and 9:20 am on or after January 25, 1967. The initial turnaround maneuver to move the maximum roll angle from its injection condition to zero degrees is illustrated. N.E.N.

N68-10106* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EARLY ORBIT AND ATTITUDE DETERMINATION PLAN AND PRELAUNCH ANALYSIS FOR THE SATELLITE TOS-C
Apr. 1967 52 p
(NASA-TM-X-63007; X-540-67-175) CSCL 22C

The primary mission of the TOS C meteorological satellite is to obtain television observations of cloud cover on an operational basis to aid in weather forecasting. This plan sets forth the responsibilities of Data Systems Division personnel in connection with orbit determination for the TOS C satellite. It is planned to launch the satellite southward from the Western Test Range (WTR) at 1113 UT (613 EST) on April 19, 1967 to achieve a near-circular, sun-synchronous orbit. Norminal values for the principal elements of the orbit are as follows: 1) period, 114.24 minutes, 2) perigee, 765.82 nautical miles (1419.28 kilometers), 3) apogee, 767.75 nautical miles (1422.84 kilometers), and 4) inclination, 101.56 degrees. Third stage burnout and satellite separation will take place about 19 minutes after launch. It is anticipated that Minitrack data will be available to make possible the determination of a preliminary orbit for TOS C within about nine hours after launch. Author

N68-10123*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STRUCTURE OF JUPITER'S MAGNETOSPHERE AND THE EFFECT OF IO ON ITS DECAMETRIC RADIO EMISSION
J. A. Gledhill Jun. 1967 32 p refs
(NASA-TM-X-55980; X-615-67-298) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A short discussion is given of the reasons for co-rotation of magnetospheres with their planets. It is shown that, if Jupiter's magnetosphere co-rotates, the plasma on any magnetic shell must tend to concentrate at those parts of the shell which are most distant from the rotational axis, because of the large centrifugal force. This would compress the plasma into a discus-shaped region about a planetary diameter thick, inclined to the equatorial plane by about 7°. The passage of this plasma over the satellite Io offers a new and attractive basis on which to explain the influence of Io on the decametric radiation of Jupiter. It is proposed that the maximum plasma frequency at Io's orbit is 40 MHz. Exploration of this possibility leads to a plasma temperature of 1800°K and a magnetic field of 30 gauss at Jupiter's equatorial surface, with the dipole displaced 0.4 planetary radius towards the north rotational pole. Some discussion of the difficulties of the theory is given and its future development is considered. Author

N68-10142*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SOME RESULTS AT BAKER–NUNN TRACKING STATIONS
L. H. Solomon 3 Jul. 1967 21 p refs
(Grant NsG-87-60)
(NASA-CR-89952; SAO Special Rept.-244) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Baker–Nunn photographs of the outburst of Nova Herculis 1963 were reduced to produce the light curve presented here. These data supplement the material available from other sources. In a second study, the limiting magnitude of the Baker–Nunn cameras was measured as a function of exposure time in dark-sky conditions. The experiment was done for several film types used in the satellite tracking program. Also given is the effect of the sky in fogging Baker–Nunn film in case of limiting dark sky. Bright-sky modification to this result is discussed. Author

N68-10150*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LUNAR ENVIRONMENT: DESIGN CRITERIA MODELS FOR USE IN LUNAR SURFACE MOBILITY STUDIES
Otha H. Vaughan, Jr. 28 Sep. 1967 47 p refs
(NASA-TM-X-53661) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The photographic data obtained by the Ranger (VII, VIII and IX), the Surveyor I, the Orbiter I, II and III, and Russia's Luna IX and XIII space vehicles have been analyzed and interpreted in

the development of lunar terrain models for use in the design of lunar roving vehicles. An attempt has been made to make the design criteria as realistic as possible with the information now available from these lunar probes. As additional information about the lunar surface is gained from additional flights of the Surveyor series, these models will be re-evaluated and revised whenever necessary. Author

N68-10151# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
THE EFFECT OF TANGENTIAL ACCELERATION ON THE MOTION OF A SATELLITE [VLIYANIYE KASATEL'NOGO USKORENIYA NA DVIZHENIYE SPUTNIKA]
Yu. G. Yevtushenko Aug. 1967 14 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), Issue 3, 1966 p 594–598
(ACIC-TC-1220; AD-656989)

The problem of the motion of a satellite under the effect of tangential acceleration, created by a low-thrust engine, has been solved in other works. This problem is of interest because numerical computations show that the tangential control of the engine thrust approximates well the solution of the problem of the optiminal boost of the satellite. An asymptotic computation of the effect of a reduced tangential acceleration on the motion of a satellite is given in this work by the averaging method. The first approximation solution computed is correct for arbitrary values smaller than a unit of the eccentricity of the satellite unit. The other approximation solution computed is for the problem in the case of near-circular orbits. Author (TAB)

N68-10164* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TABULATED COMMUNICATION CHARACTERISTICS OF A STEADY-STATE MODEL OF INTERPLANETARY SPACE
Ronald J. Hruby, Austin H. Somes, John Dimeff, and Howard Tashjian Washington NASA 1967 526 p refs
(NASA-SP-3042) CFSTI: $3.00 CSCL 03B

The changes in an electromagnetic wave as it passes through interplanetary and coronal space depend on the intervening plasma and magnetic fields. These changes are presented as a function of the transmission range and the view angle relative to the earth–sun line in the ecliptic plane. This information can be used to determine the total change in an electromagnetic wave between any two points in the earth–sun volume excluding the magnetosphere. Models for the electron density, the magnetic fields, and the solar wind were derived from the best available estimates and experimental data. Tabulated data are derived from a steady-state model of the coronal space corresponding to a simplified quiet sun. The spiral pattern of the magnetic field model is considered to have no disordering effects, and the model of the electron density is a function of solar radial distance only. The interplanetary space is considered to be a neutral plasma with equal densities of electrons and protons. Communication between any two points within the earth's orbit and in the ecliptic plane can be analyzed from the tabulated data. Author

N68-10169* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON A MATHEMATICAL FORMULATION OF THE CONSTITUENT INVERSION PROBLEM FOR PLANETARY ATMOSPHERES
Barney J. Conrath Oct. 1966 15 p refs
(NASA-TM-X-63021; X-622-66-542) CSCL 03B

One possible formulation of the problem of inferring vertical constituent distribution in planetary atmospheres from remote infrared radiance measurements is discussed. The solution to the non-linear integral equation of radiative transfer is approximated by an iterative procedure which involves the solution of a linear Fredholm integral equation of the first kind. In this way techniques developed for the solution of the temperature inversion problem can be applied (e.g., the use of empirical orthogonal functions). An example of the application of the formulation to the inference of vertical water vapor distribution in the terrestrial atmosphere is given, and the results are found to be encouraging. It is concluded that further study of the method is warranted. Author

N68-10210*# Ohio State Univ., Columbus. Electroscience Lab.
THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE ELECTROMAGNETIC SCATTERING AND RADIATIVE PROPERTIES OF TERRAIN, WITH EMPHASIS ON LUNAR-LIKE SURFACES Final Summary Report
7 Nov. 1967 11 p refs (Grant NsG-213-61) 7 Nov. 1967 11 p refs
(Grant NsG-213-61)
(NASA-CR-89957; FR-1388-27) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Brief accounts are presented of the results of two experimental studies of lunar surface features using radar techniques. Results cited include: (1) Lunar RMS surface slope at a wavelength of 13.2 cm is about 15#; lunar cross section is about 6 percent for direct (linear) polarization and about 0.4 percent for cross polarization (both ±3 db); and the average dielectric constant of the moon's surface is $\epsilon \approx 2.6$. (2) The RMS surface height is essentially independent of the examining wavelength, depending primarily on the RMS height of the largest scale structure. E.C.

N68-10278* Smithsonian Astrophysical Observatory, Cambridge, Mass.
SATELLITE ORBITAL DATA NUMBER E-8
Beatrice Miller 10 Nov. 1967 45 p ref
(Grant NsG-87-60)
(NASA-CR-90037; SAO Special Rept.-257) CSCL 22C

Mean orbital element data are presented, in which the effects of the short-period perturbations due to the earth's oblateness were eliminated. Using the differential orbit improvement program, these elements were derived from precisely reduced observations covering several days. While the successive sets of elements are essentially independent of each other, they are dependent in the sense that high order coefficients in the secular and the long periodic terms are generally considered as known and as constant for periods of several weeks or months. The tabulations give the values of arguments of perigee, right ascension of the ascending node, inclination, eccentricity, and mean anomaly as functions of time. Tables also show the station coordinates, the values of the tesseral harmonics and the constants, and the zonal harmonics. M.G.J.

N68-10285*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTIMUM FLIGHTS WITH PRESSURE OF LIGHT TAKEN INTO ACCOUNT
S. N. Kirpichnikov Redstone Arsenal, Ala. Redstone Sci. Inform. Center 30 Aug. 1967 27 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (USSR), no. 7, 1965 p 144–156 Sponsored in part by Army Missile Command
(NASA-TM-X-60601; RSIC-703) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The construction of single-impulse trajectories of interorbital flights with a minimum consumption of mass in the gravitational field of the sun (a spherical central body radiating light symmetrically) is discussed. Disregarded is the perturbing action of the space vehicle caused by objects in space located on the specified boundaries of the Kepler orbits. It is assumed that all three orbits, the initial, intermediate, and final, are located in one plane and that the motion along these orbits is proceeding in one direction. Author

N68-10357*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LONG-PERIOD VARIATIONS IN THE ECCENTRICITY AND ARGUMENT OF PERIGREE OF NIMBUS 2
Theodore L. Felsentreger May 1967 14 p refs
(NASA-TM-X-63011; X-547-67-234) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Long-period variations have been observed in the mean values of eccentricity and argument of perigee (published by the Goddard Space Flight Center) for Nimbus 2. It is shown that the use of a more recent determination of the earth zonal harmonic coefficients, plus additional first-order earth oblateness perturbations (for small eccentricity satellites) not included in the mathematical model for orbit determination, explains these variations. Author

N68-10411*# National Aeronautics and Space Administration. Goodard Space Flight Center, Greenbelt, Md.
INTERPLANETARY TRAJECTORY ENCKE METHOD (ITEM) UPDATE 12C PROGRAM MANUAL
L. Lefton and F. Whitlock Jun. 1967 139 p refs
(NASA-TM-X-55841; X-643-67-295) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A general purpose interplanetary trajectory Encke method program for the IBM 7090 and IBM 7094 is described. The method employed is designed to give the maximum available accuracy without incurring prohibitive penalties in machine time. The perturbations included in this program are the gravitational attractions of earth, moon, sun, Jupiter, Venus, and Mars considered as point masses. Additionally, the effects of the second, third, and fourth zonal harmonics and the tesseral harmonics earth and moon gravitational fields are considered. The aerodynamic drag, small corrective thrusts, and radiation pressure including the shadow effect of the earth, are considered. The input may be prepared in any one of several common systems and a great variety of output options is available. Author

N68-10564* Boeing Co., Seattle, Wash.
LUNAR ORBITER I
29 Sep. 1967 497 p refs
(Contract NAS1-3800)
(NASA-CR-66481; D2-100727-7) CSCL 22A

The postflight supporting data for the photo phase of Lunar Orbiter I are described and tabulated. The evaluation computer program and the ephemeris version used are described. Input data from card and magnetic tape are used, and are grouped into state vectors, attitude maneuvers, photo times, planetary constants, and spacecraft constants. The photographic evaluation program output data are also defined. The spacecraft and planetary constants are listed, along with the orbit determination reports, lunar harmonic summaries, and all the data cards input to the photographic evaluation program. N.E.N.

N68-10614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF MOON AND PLANETS IN KAZAKHSTAN
V. G. Teifel 18 Aug. 1967 23 p Transl. into ENGLISH from Vestn. Akad. Nauk Kaz. SSR (Alma-Ata), v. 20, no. 8, 1964 p 9–17
(FTD-MT-66-104; AD-659312)

This article lists some of the important problems confronting astrophysicists in connection with the preparation and realization of interplanetary flights of automatic stations and man. Basic results of over 30 works dedicated to the study of the physics of planets and satellites of solar system are enumerated. TAB

N68-10651# Arizona State Coll., Flagstaff.
RESEARCH IN ASTRONOMICAL PHOTOMETRY AND POLARIMETRY CONCERNING W SERPENTIS AND THE ORION NEBULA, NGC 1976 Final Report
Richard C. Hall 30 Sep. 1967 9 p ref
(Contract N00014-67-C-0192)
(AD-659202)

Photoelectric measures on 33 nights of the star W Serpentis were made. A new time of minimum light and a new period are established as JD Hel 2,439,297.725 + 14.d1592E. Polarimetric measures indicate no measurable change in polarization around time of minimum light. First results on the polarization of the emission lines and the continuum of the Orion Nebula, NGC 1976, are reported. Tentative conclusions are: (1) The emission lines appear to be unpolarized near the Trapezium and gradually increase in polarization with distance from the Trapezium to match the continuum polarization; (2) The high continuum polarization of one area near the Trapezium (Area I) is not shared by the emission lines; (3) The 5007A filter shows an anomalous high polarization for an area distant from the Trapezium (Area IV). Author (TAB)

N68-10659# Belgian Royal Observatory, Uccle.
EPHEMERIS CATALOGUE OF RADIAL VELOCITIES RELATIVE TO THE COMPONENTS OF VISUAL DOUBLE STARS WHOSE ORBITS ARE CONTINUOUS [CATALOGUE D'EPHEMERIDES DES VITESSE RADIALES RELATIVES DES COMPOSANTS DES ETOILES DOUBLES VISUELLES DONT L'ORBITE EST CONNUE]
J. Dommanget and O. Nys 1967 205 p refs In FRENCH *Its* Commun., Ser. B, No. 15

An emphemerides catalog gives radial distribution curves for visual binary stars with continuous orbits for the period between 1955 and 1975. Standard index numbers for the stars are used, and these are between 00001 N 5753 and 23589 N 2633 AB. Sources of the stellar orbits are included, along with the position angles and inclinations of the stars. The mathematical scheme for developing the catalogue is presented, including the flow chart for the computer calculations. Transl. by M.W.R.

N68-10669*# Houston Univ., Tex. Naval Propagation Lab.
THE WORST CASE LUNAR SURFACE MODEL
H. S. Hayre and A. Tong Oct. 1967 6 p refs
(Contract NAS9-6760)
(NASA-CR-65798; TR-67-18) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The necessity is cited for designing a lunar surface model that takes into consideration the many different lunar surface features while biasing the altimeter radar signal in the worst possible way. This model would be used for ultrasonic simulation of the landing module radar signal return. A possible worst case lunar surface

model sketch is shown in which significant features are a rill and ridge which run side by side. It is intended that the sketch be used to study altimeter radar backscattering. A second illustration examines radar beam coverage of the lunar surface as the vehicle is descending along the trajectory. E.C.

N68-10701*# Control Technology, Inc., Long Beach, Calif.
ERROR ANALYSIS OF HYBRID SIMULATION FOR SPACECRAFT RE-ENTRY STUDIES Final Report
A. S. Jackson and R. V. Morse 1967 159 p refs
(Contract NAS9-3437)
(NASA-CR-65785) CSCL 22C

A quantitative analysis was made of the potential use of the electronic differential analyzer (EDA) and the digital differential analyzer (DDA) in the simulation of complex aerospace problems. Emphasis was placed on errors associated with simulating a spacecraft using a six-degree-of-freedom model. The s and z-transform techniques were used to determine the characteristic root errors caused by imperfect computing elements and time delays. A parametric study was made of the model's second order loops, with and without coupling. Time simulations of the same systems studies by characteristic root analysis were performed and the corresponding time dependent errors were compared with those obtained in the s and z-plane analysis. Simulation experiments were conducted using six-degree-of-freedom model to validate the analytical results and to assess the effects of nonlinearities. Conclusions and guidelines for the optimal use of both the EDA and DDA are discussed in detail. R.N.A.

N68-10703* University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
SUMMER INSTITUTE IN SPACE TECHNOLOGY Final Report
Roy Scott Hickman [1967] 255 p refs 4th Ann. Summer Inst. in Space Technol. Held in Los Angeles, 18 Jun.–31 Jul. 1967
(Contract NSR-05-018-055)
(NASA-CR-90031) CSCL 22C

The proceedings of the NASA sponsored Summer Institute in Space Technology are described. As part of the program, the students were presented with a Request For Proposal for auxiliary solar sensors for a planetary tracker. The students were organized into three groups to prepare technical and management proposals for the solar sensors. Details of these three proposals are appended. R.N.A.

N68-10711*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF INSERTION SHIP TRACKING ERRORS ON THE APOLLO GO, NO-GO DECISION
B. Kruger and C. W. Murray, Jr. 28 Apr. 1967 84 p refs
(NASA-TM-X-55979; X-507-67-181) CFSTI: HC $3.00/MF $0.65 CSCL 22A

After insertion into the near-earth parking orbit a Go, No-Go decision has to be made, based on one minute of ship's tracking data. The deciding factor for the Go, No-Go decision is the perigee height of the parking orbit; a minimum perigee height of 75 n.mi. is required. In this paper, a statistical analysis has been made of the error in the perigee height, as determined from one minute of ship's tracking data. It is shown, that the computed perigee height has to be 0.5 to 17 n.mi. higher than 75 n.mi. in order to insure that the actual perigee height exceeds 75 n.mi. with 99.5% probability. The use of a 17 n.mi. padding is recommended in order to cover worst case conditions. Author

N68-10748 Lockheed Missiles and Space Co., Palo Alto, Calif.
EXPERIMENT ON MOLECULAR GENERATOR OPERATION ON AN ARTIFICIAL EARTH SATELLITE
N. G. Basov, M. I. Borisenko, V. P. Vlasov, S. P. Dubonosov, N. E. Ivanov et al [1967] 11 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 4, 1967 p 608–615

Results of the first experiment conducted to study molecular generator operation on an artificial earth satellite are briefly expounded. The frequency stability of the molecular generator was measured by using a system of duplex radio communication with the satellite, in which the frequency shift because of the Doppler effect was automatically compensated to a value $<10^{-8}$ of its magnitude. The on-board molecular generator had a frequency instability on the order of 10^{-11} during continuous operation in one measurement session, and somewhat more than 10^{-10} during the long time it was disconnected between observation sessions. Author

N68-10822* Vermont Univ., Burlington.
THE SHAPES OF TOMORROW—A SUPPLEMENT IN SPACE ORIENTED GEOMETRY FOR SECONDARY LEVELS
Washington GPO 1967 211 p Prepared for NASA
(NASA-CR-90075) GPO: $1.50 CSCL 22A

It is logical to presume that major achievements in the exploration of space rest with the youth of today and with the education they receive. It is therefore our sincere concern that the space program be conducted in close cooperation with our Nation's educational institutions. Understandably, young people throughout the land are fascinated by the era of space travel. Teachers and students have long demonstrated their eagerness to relate the subjects they study to the space program. However, frequently there appears to be a lack of available reference material suitable for classroom use. In view of the continuing demand for such material, especially for elementary and secondary levels, the NASA/Goddard Space Flight Center, in cooperation with the U.S. Office of Education, has initiated a program of summer workshops to develop space-oriented mathematics supplements. This publication, the third in the series, focuses on the use of geometric concepts. Author

N68-10900* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETERMINATION OF THE TIME IN WHICH AN ARTIFICIAL EARTH SATELLITE IS ILLUMINATED BY THE SUN [OPREDELENIYE VREMENI OSVESHCHENNOSTI ISKUSSTVENNOGO SPUTNIKA ZEMLI SOLNTSEM]
A. A. Karytov Sep. 1967 6 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 2, 1967 p 298–301
(Contract NAS7-100)
(NASA-CR-90059) CSCL 22C

A mathematical discussion of the time of illumination is presented. The orbit is considered to be an ellipse with small eccentricity and with one focal point coinciding with the earth's center. Low altitude satellites are also assumed, so that the earth's shadow has the form of a right circular cylinder. The case in which the satellite is illuminated throughout the entire revolution is mentioned. N.E.N.

N68-10937* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MARINER IV FLIGHT PATH AND ITS DETERMINATION FROM TRACKING DATA
G. W. Null, H. J. Gordon, and D. A. Tito 1 Aug. 1967 220 p refs
(Contract NAS7-100)
(NASA-CR-89968; JPL-TR-32-1108) CSCL 22C

This report describes the current best estimate of Mariner IV spacecraft flight path and the way in which it was determined. Mariner IV successfully completed its mission to Mars by returning man's first close-up pictures of Mars, dramatically improving knowledge of the atmosphere of Mars, and measuring the magnetic field and charged particle environment around the planet. Postflight analysis of the tracking data resulted in a very significant order-of-magnitude improvement in the mass of Mars; a new, provisional value of the astronomical unit (AU); a confirmation of the values of the gravitational constants of Earth and Moon as determined by earlier Ranger and Mariner missions; and valuable data on tracking station locations. Author

N68-10969* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
PRE-WHITE DWARF EVOLUTION, III
Samuel C. Vila (Indiana Univ.) [1967] 23 p
(NASA-TM-X-60603) CFSTI: $3.00 CSCL 03B

Stars of masses between 0.2 and 1.2$M_{\odot}$ in those stages of their evolution in which the matter becomes degenerate were previously studied. The neutrino reactions were included and the sequences of models were stopped when the neutrino luminosity was too small to influence the further evolution and the formation of an ion lattice would invalidate the equation of state used. In the cores of dense white dwarfs the ions are arranged in a lattice. A simplified model is studied to calculate the changes in the thermodynamic properties due to the existence of a lattice of finite temperatures. This model takes into account the major correction term due to the electron–lattice interaction. The main purpose was to estimate the changes introduced in the cooling times of white dwarfs by the ion lattice. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-10066*# TRW Systems, Redondo Beach, Calif.
VOYAGER SUPPORT STUDY; LM DESCENT STAGE APPLICATIONS. VOLUME IV: GUIDANCE AND CONTROL STUDIES Final Report
Jul. 1967 337 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-89996; TRW-04480-6007-R000, Vol. IV) CFSTI: $3.00 CSCL 22B

A performance assessment is made of the attitude control system during coast phases of the Voyager flight, and of the thrust vector control system during powered flight. The effects of low-g propellant slosh on the attitude control system is discussed, and the transition from the powered flight to the cruise mode is investigated. To determine gain and phase stability margins for rigid body operation propellant slosh modes and spacecraft body bending modes, linear control system models were used for the powered flight control system stability analyses. Control system stability margins with various autopilot filter designs, propellant damping variations, and electronic integrator designs are determined, and gain–phase stability plots are given. The performance of integral feedback loops in the reduction of powered-flight thrust vector pointing errors is reviewed, and the effects of three control system designs on the thrust-vector-induced pointing errors are evaluated. The electromechanical clutch-driven actuator was found suitable for use in the Voyager spacecraft, using the modified lunar module descent engine. M.G.J.

N68-10069*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
PRELIMINARY ANALYSIS OF THE EFFECTS OF PRESSURE SPACE CORRELATIONS ON THE VIBRATIONS OF APOLLO FLIGHT STRUCTURE
R. W. White and M. J. Crocker May 1968 82 p refs
(Contract NAS9-4305)
(NASA-CR-65808; WR-68-32) CFSTI: $3.00 CSCL 22B

This report contains a preliminary analytical investigation of the vibration response of Apollo skin structure to convected boundary layer turbulence, with emphasis on the variations of the response amplitudes with longitudinal and lateral correlation lengths. The portion of the Apollo considered is the truncated conical Spacecraft Lunar Excursion Module Adaptor (SLA); and for purposes of this analysis, this structure is treated as an equivalent simply supported, uniform, flat, rectangular, honeycomb plate having essentially the same dynamic characteristics as the SLA. The response spectral density is computed for a pressure space correlation pattern having the functional form of an exponentially damped cosine along, and normal to, the flow axis. By including over 300 modes of the plate, a cursory parameter study is made to show how the response levels of the essentially discrete modes vary with longitudinal and lateral correlation lengths and convection velocities. Author

N68-10080*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRAPPED RADIATION DETECTOR—*MARINER V*
Henry Canvel 15 Nov. 1967 17 p
(Contract NAS7-100)
(NASA-CR-89924; JPL-TR-32-1197) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The trapped radiation detector (TRD) was one of the scientific instruments selected for the *Mariner V* flyby mission to Venus in 1967. The instrument was designed and fabricated at the University of Iowa, under the direction of Dr. J. A. Van Allen. The experimental objectives were to perform further studies of geomagnetically trapped particles, interplanetary radiation levels including solar X-rays, and search for the existence of magnetically trapped particles in the vicinity of Venus. Detailed descriptions are shown in the test, which include the design, test history, methods of calibration and data handling techniques. Also discussed are the look angles, geometric factors, and energy levels of the various detectors used in the instrument. Included in this report is a complete history of the developmental problems encountered during the fabricating and testing effort, and the corrective action taken to make the instruments flightworthy. The *Mariner IV* TRD was modified to meet the *Mariner Venus* 67 mission requirements. Author

N68-10141* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ASTROBEE 1500 FLIGHT 16.05 US INSTRUMENTATION AND CALIBRATION DATA
C. D. Tackett Mar. 1967 114 p
(NASA-TM-X-63009; X-721-67-199) CSCL 22D

A compilation of calibration data and curves for the airborne instrumentation system used on Flight 16.05 US of the Astrobee 1500 is presented. Also included are the payload telemetry and commutator allocations used, and data resulting from preflight testing performed at Goddard Space Flight Center and at Wallops Island, Virgina. Author

N68-10165* Ball Bros. Research Corp., Boulder, Colo.
APOLLO TELESCOPE MOUNT EXTENDED APPLICATIONS STUDY PROGRAM: ATM CONTAMINATION STUDY Final Report
D. G. McPherson 25 May 1967 215 p refs
(Contract NASw-1386)
(NASA-CR-61173) CSCL 22B

An evaluation was made of the absorption and scattering of electromagnetic radiation by molecular species, based on quantities of materials emitted and the estimated mean velocities of the molecules, assuming spherical expansion about the ATM/Cluster. Absorption and scattering cross sections from literature were used. It was concluded that the effect of absorption and scattering by molecular species will be negligible for all experiments, assuming that the Reaction Control System firing for Control Moment Gyro desaturation is scheduled for the onset of the dark side of the orbit. Photon scattering by particulate debris was evaluated, concluding that water from the Water Subsystem in the Command Service Module is by far the major threat. Number and size distribution was treated from a theoretical basis. Lifetime of ice particles, considering drag forces and thermal effects, was evaluated, with consideration given to electrostatic and/or magnetic coupling to the spacecraft. The probability of nucleation of molecular species was treated, and found to be quite improbable. The surface brightness of the particulate matter about the ATM/Cluster was estimated, showing it to be on the same order of magnitude as the irradiance being measured. Hence, scattering from particulate matter poses a serious threat to the white light coronagraph, but not to the other experiments. It was concluded that action may be taken which would significantly reduce the quantity of particulate matter between the ATM and the sun. Author

N68-10192*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL TEST CONTRIBUTION TO SPACECRAFT RELIABILITY
Kenneth R. Mercy Washington, NASA, Nov. 1967 17 p Presented at Inst. of Environ. Sci. Ann. Tech. Meeting, Washington, D. C., 11 Apr. 1967
(NASA-TN-D-4181) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Typical problems that have a major impact on some space programs are discussed. These problems include those that involve the interdependence of equipment in a system complex. The experiences obtained in producing reliable spacecraft for several programs (Relay, Syncom, Tiros, etc.) are analyzed. The techniques used to control and appraise space programs differ and are influenced by the spacecraft design, target dates, and budget restrictions. The validity of these techniques is indicated by the results of the test programs. Problem occurrences are analyzed relative to program phase. The results of this study are discussed with regard to optimizing techniques of quality and reliability planning for space hardware. Author

N68-10220# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
WIND-TUNNEL STUDY OF AN HYPERSONIC REENTRY LIFTING BODY [ETUDE AERODYNAMIQUE D'UN CORPS DE RENTREE PORTANT EN HYPERSONIQUE]
Rene Ceresuela 1967 23 p refs In FRENCH; ENGLISH summary
(ONERA-TN-110(1967)) CFSTI: HC $3.00/MF $0.65

A lifting reentry body was tested up to Mach 16.5 and at angles of attack up to 50°. When compared to the newtonian predictions the wind tunnel test results outline the limitations of this theory with regard to the interaction of the blunt nose with the aerodynamic field. The efficiency of conventional elevons was investigated as well as the evolution of the yaw stability as a function of the Mach number and of the angle of attack; the good performance of twin lateral fins is explained. The kinetic heating rate distribution at high angles of attack, measured by means of thermosensitive paints, is discussed. Author

N68-10239*# TRW Systems, Redondo Beach, Calif.
VOYAGER SUPPORT STUDY; LM DESCENT STAGE APPLICATIONS. VOLUME V: CONFIGURATION STUDY
Jul. 1967 66 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-89997; TRW-04480-6008-R000, Vol. V) CFSTI: $3.00 CSCL 22B

A gross preliminary design of a spacecraft configuration was developed in order to assess the effect of a weight reduction of 2000 pounds. Emphasis was placed on the propulsion aspects of the spacecraft design, using the lunar module descent engine as a basic element, and a blowdown mode of operation for midcourse maneuvers. Spacecraft subsystems are described, weight estimates are developed, and control moment capabilities and powered flight slosh stability considerations are summarized. To achieve spacecraft modularity, a propulsion module was designed which allows the remaining equipment module, containing all nonpropulsion spacecraft elements, to be assembled and tested separately. The preferred configuration is depicted and described, along with two alternate configurations. M.G.J.

N68-10259*# TRW Systems, Redondo Beach, Calif.
VOYAGER SUPPORT STUDY: IMPLEMENTATION DEFINITION Final Report
Jul. 1967 96 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-89998; TRW-04480-6010-R000) CFSTI: $3.00 CSCL 22B

In this study, previously developed project concepts were extended in terms of implementation definitions covering developmental and operational activities, schedules, and project costs. The approach of the study was to identify and evaluate alternatives so as to arrive at reference implementation definitions. Defined are project evolution, elements, and organization. Spacecraft features, systems, and testing are discussed in addition to capsule performance, system integration, contamination control, and the tracking and data acquisition system. Other implementation studies were made of the radioactive thermodynamic generator, the surface laboratory, the mobile unit, and the launch vehicle. Launch and mission operations are outlined, and a functional management plan is given. K.W.

N68-10328 Bolkow Entwicklungen K. G., Munich (West Germany).
OPTIMIZATION ASPECTS AND TEST RESULTS OF A CRYOGENIC UPPER STAGE TANK INSULATION
M. Leupold and E. Mueller [1967] 35 p Presented at the 6th European Space Symp.

Theoretical considerations and initial experimental results are presented on an investigation of composite insulations for a LH_2/LOX propellant tank. Foam is considered to be the best for insulation for on-ground conditions, and multilayer metal foil for space insulation. Details are given on the properties of PVC and polyurethane foams and on aluminized Mylar foil. Methods of applying foam and multilayer foil insulation to tanks are described, and preliminary results are discussed. N.E.N.

N68-10370*# General Electric Co., Philadelphia, Pa. Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Missile and Space Div.
SUMMARY, VOLUME I Final Report
K. C. O'Leary 28 Jul. 1967 63 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-89994; VOY-CO-FR Vol. I) CFSTI: $3.00 CSCL 22B

In addition to a preliminary design study of a Voyager spacecraft powered by radioisotope thermoelectric generators (RTGs), this volume summarizes the results of studies concerned with planetary quarantine, redundancy application, and data management and control. The impact of the use of RTGs upon the spacecraft and mission design is examined. Application and practical use of redundancy in the Voyager missions was studied in both the spacecraft system and mission levels. The effect of planetary quarantine constraint on design and fabrication of the spacecraft and mission was determined. The Voyager data management and project control requirements are described as well as approaches for meeting these requirements. K.W.

N68-10371*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RTG SPACECRAFT STUDY, VOLUME 2 Final Report
A. Kriprih 28 Jul. 1967 241 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-89995; VOY-CO-FR, Vol. 2) CFSTI: $3.00 CSCL 22B

This study discusses the application of radioisotope thermoelectric generators (RTGs) to provide electric power to the Voyager spacecraft bus. The objective was to develop an RTG spacecraft design equaling or surpassing the capability of earlier solar-powered designs. Guidelines and design evolution of the RTG spacecraft are given. The results of related studies concerning RTG integration, thermal analysis, radiation flux distribution, subsystem design, and operational support equipment definition support the basic spacecraft description. Modifications required to convert the spacecraft to a solar-powered version are discussed, and the RTG is compared with a solar-powered version developed for interchangeability purposes. The results are given of supporting studies concerning: (1) sensitivity of spacecraft and science equipment to RTG radiation; (2) RTG power, weight, dimensions, and thermal behavior; and (3) safety considerations. Program management and work flow charts are included. K.W.

N68-10385*# TRW Systems, Redondo Beach, Calif. Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VOYAGER SUPPORT STUDY: IMPLEMENTATION DEFINITION Final Report
Jul. 1967 471 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-89999; TRW-04480-6009-R000) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Voyager project technical plan and system elements are reviewed followed by implementation considerations covering project organization and management, implementation phasing, project flow and schedule, reliability and quality assurance, planetary quarantine, functional management, and missions analysis and engineering. Implementation definition is then presented individually for the major system elements, including mission operations, the tracking and data acquisition system, launch site operations, the launch vehicle system, the spacecraft system, the capsule, the radioisotope thermal generator, the surface laboratory, and the mobile unit. R.N.A.

N68-10397* National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE FLIGHT: PROJECTS MERCURY AND GEMINI
[1967] 12 p
(NASA Facts 9/Vol. 2, No. 8) GPO: $0.15 CSCL 22B

A journalistic review of the Mercury and Gemini space flights is presented. The spacecraft, its systems, and communications are briefly described. Prelaunch checkouts, rendezvous, reentry, and recovery activities are outlined. The criteria for the pilot-astronauts and the scientist-astronauts are indicated, along with their training program. Definitions of terms and photographs are included. N.E.N.

N68-10422*# Minnesota Univ., Minneapolis. Cosmic Ray Group.
APPLICATION OF AN INTEGRATING TYPE IONIZATION CHAMBER TO MEASUREMENTS OF RADIATION IN SPACE
Sharad Ramchandra Kane (Ph.D. Thesis) Sep. 1967 221 p refs
(Contract NAS5-2071)
(NASA-CR-90060; CR-106) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An integrating type ion chamber experiment, using a resetting drift-type electrometer and designed to fly on the OGO-I and III satellites is described. The chamber is demonstrated to have an accuracy and stability of $\approx 1\%$ during its operation in space over a period of nearly three years. The minimum energy for penetration by protons and electrons is 12 and 0.6 MeV respectively. The response to 40 KeV electrons (through bremsstrahlung) is about $10^{-7}\times$ (response at energies >600 KeV). The response to X-rays in 10–150 KeV range is peaked at ≈ 20 KeV; below 10 KeV the response is $\approx 10^{-2}\times$ (response at 20 KeV). For 1 particle cm^{-2} sec^{-1} of 20 KeV photons, electrons with energy ≥ 1 MeV, and minimum ionizing nuclei with charge Ze the pulsing rate of the chamber is respectively 0.2, 7.0, and 5.5 Z^2 NPPS (Normalized Pulses Per Second) $\times 10^3$. Author

N68-10510* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PRELAUNCH ANALYSIS AND ATTITUDE CONTROL SYSTEM DESCRIPTION FOR THE SATELLITE OSO-E1
Feb. 1967 44 p
(NASA-TM-X-63005; X-547-67-91) CSCL 22B

In the prelaunch analyses of the OSO-E1, consideration is given to launch window computation and data availability. The planned attitude control operation is discussed, and descriptive details are given on the attitude determination and prediction program system, and the method of approach to the problem of magnetic attitude control. Author

N68-10537* Boeing Co., Seattle, Wash.
LUNAR ORBITER III: APPENDICES
2 Oct. 1967 553 p
(Contract NAS1-3800)
(NASA-CR-66484; D2-100753-6) CSCL 22B

Tabulated data are presented for Mission III. The cross reference index provides a method by which the lunar surface photographs may be identified with respect to readout periods and to actual photo sites. The FPAC supporting data include spacecraft maneuvers and tracking data, orbit determinations, DSIF view periods, and apolune/perilune and on–off times. Tables of the complete sequence of events and operational activities are also given. N.E.N.

N68-10667*# North American Aviation, Inc., Downey, Calif. Space Div.
A STUDY OF ELECTRONIC PACKAGES ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION. APPENDIX: THERMAL ANALYSIS DATA, PART 3 Final Report
D. J. Watanabe 21 Jul. 1967 574 p
(Contract NAS8-20320)
(NASA-CR-90104; SID-67-373-3, Append. Pt. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Graphs resulting from the thermal analysis are presented for the 19,327 nautical-mile synchronous orbit. The variables include X, Y, and Z axes, IU outer skin α_s, heat load/coldplate, and coolant inlet temperature. N.E.N.

N68-10669*# Auburn Univ., Ala. School of Engineering.
JOVE, JUPITER ORBITING VEHICLE FOR EXPLORATION. VOLUME II APPENDIXES
Aug. 1967 192 p refs
(Contract NSR-01-003-025)
(NASA-CR-61180, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Supporting engineering and scientific data are presented for JOVE. Details on the gravitational, electromagnetic, and particle field, and on the atmospheric composition and structure of the planet Jupiter are discussed. The meteoroids, asteroids, comets, galactic cosmic radiation, solar wind and flares, and magnetic fields in the interplanetary space are also considered. Radio occultation measurements from a single orbiting vehicle and from a pair of orbiting vehicles, and detailed structure calculations are given. Alternate considerations are described for the antenna and for the radioisotopic thermoelectric generator power supply system. The on-board navigation and guidance system, and the LEM engine exhaust jet effects are covered. N.E.N.

N68-10668 Entwicklungsring Nord, Bremen (West Germany).
PRESENT DEVELOPMENT SITUATION OF STRUCTURE AND ENGINES OF THE THIRD STAGE FOR THE ELDO-A-SATELLITE LAUNCHING SYSTEM
Hans E. W. Hoffmann [1968] 17 p Presented at the 6th European Space Symp., Brighton, 23 May 1966 CSCL 22D

A review of structural problems encountered in the design of the third stage propulsion engines of the ELDO A Satellite Launching Systems is presented. Three successful Blue Streak firings were conducted so far. Thrust, combustion efficiency, chamber pressure, expansion ratio, and propellant mixture ratios, and sloshing problems are examined. L.S.

N68-10704# Defense Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I—THE FIRST THREE YEARS IN ORBIT
I. Paghis, C. A. Franklin, and J. Mar. Apr. 1967 95 p refs
(DRTE-1159) CFSTI: $3.00

The scientific results of the Alouette I ionospheric studies are discussed along with background information on the history and organization of the Alouette project and a brief mention of the satellite design and performance. The results deal with electron number density, ionospheric resonances, other very low frequency emissions, extraterrestrial high frequency emissions, and associated research. Details are also included on the design and performance of the satellite's electrical systems, and on the mechanical design and environment aspects of the satellite. R.N.A.

N68-10706* Boeing Co., Seattle, Wash.
LUNAR ORBITER IV: APPENDICES
20 Oct. 1967 352 p
(Contract NAS1-3800)
(NASA-CR-66499; D2-100754-6) CSCL 22B

These appendices on the Lunar Orbiter IV mission contain: (1) a method by which lunar surface photographs can be identified with respect to readout periods and to actual photo sites on the lunar surface; (2) a tabulation of spacecraft maneuvers for Mission IV and information regarding the editing of tracking data for Mission IV; and (3) the mission sequence of events program which was designed to generate a complete integrated schedule of operational activities and significant events for Lunar Orbiter missions. R.N.A.

N68-10887*# Auburn Univ., Ala.
JUPITER ORBITING VEHICLE FOR EXPLORATION. VOLUME I: MISSION AND SYSTEM STUDY Final Report
Aug. 1967 399 p refs
(Contract NSR-01-003-025)
(NASA-CR-61180, Vol. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

JOVE (Jupiter Orbiting Vehicle for Exploration) is the preliminary design of a Voyager class space vehicle with a proposed launch date in the late 1970's or early 1980's. Studies and tradeoffs of complete systems were made and layouts are presented for a recommended and an alternate configuration. The JOVE vehicle has an extended mission time of 800 to 900 days in transit with at least 100 working days in orbit around Jupiter. It uses eight radioisotope thermoelectric generators, a fixed high gain antenna, and a gimballed attitude control reference-axis system. Many of the vehicle's systems and components are similar to Voyager but it is considered to be a simpler vehicle than either Voyager or the Apollo lunar landing vehicle. This simplicity will help overcome reliability programs associated with the long mission time. The vehicle has extensive micrometeroid protection and is completely insulated from the space environment. Heat rejected from the radioisotope generators will be used for thermal control. The spacecraft's scientific packages are described in detail and recommendations on the value of the mission are given. R.N.A.

N68-10941*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
DECONTAMINATION TECHNIQUES FOR LUNAR ORBITING SPACECRAFT
Francis N. Le Doux Oct. 1966 7 p Presented at the 17th Congr. of the Intern. Astronautical Federation, Madrid, Oct. 1966
(NASA-TM-X-55999; X-723-66-526) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The decontamination techniques discussed in this paper were applied to the AIMP spacecraft structure and the electronic instrument modules. Briefly described are the decontamination techniques developed, the decontamination solutions applied, the methods employed for recovering viable organisms, the spacecraft assembly environment, and the overall results of the decontamination effort. Two methods of recovering viable organisms from the spacecraft surfaces were employed: one used control strips with detachable coupons, the other sterile swabs and templates to sample surfaces prior to their occlusion by attachments. Charts are included which show the areas decontaminated, the methods and solutions used, and the method of recovering viable organisms. K.W.

N68-10947* Boeing Co., Seattle, Wash.
LUNAR ORBITER IV: MISSION SYSTEM PERFORMANCE
18 Oct. 1967 143 p refs
(Contract NAS1-3800)
(NASA-CR-66498; D2-100754-3) CSCL 22B

Details of the Lunar Orbiter IV launch operations, flight operations, spacecraft performance, and ground data system performance are described. Also discussed are lunar environmental data recorded by Lunar Orbiter IV and the principal malfunctions which occurred during its mission. R.N.A.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-10010# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
THE NONDESTRUCTIVE DETERMINATION OF THE DYNAMIC ELASTIC CONSTANTS OF BeO
J. P. Clark and J. Osborne 31 Jul. 1967 13 p refs Presented at the Seminar on Determination of Phys. Properties on Mater. through Sonic Resonant Methods, Columbus, Ohio, 3–4 Nov. 1965
(Contract AT(40-1)-2847)
(GEMP-537; CONF-651125-2) CFSTI: HC $3.00/MF $0.65

Sonic and ultrasonic resonant-frequency techniques to determine the dynamic elastic constants of extruded BeO rods are presented. Special techniques and equipment for measuring the fundamental and harmonic frequencies of the flexural, longitudinal, and torsional modes of vibration of short rods are discussed. Data were collected involving the elastic constants of several types of BeO with and without additives, as a function of temperature, density, grain size, and neutron irradiation. Additional data showing the relation between the fundamental resonant peaks and corresponding high harmonics are discussed. Author (NSA)

N68-10091* Minnesota Univ., Minneapolis.
ON THE ELASTIC PROPERTIES OF ANISOTROPIC HETEROGENEOUS MATERIALS
H. H. Kausch-Blecken von Schmeling Apr. 1967 39 p refs
(Grant NGR-24-005-070)
(NASA-CR-89975; TR-112) CSCL 20K

The macroscopic elastic properties of heterogeneous bodies are studied in terms of the elastic properties of freely orienting microscopic units. Special attention is given to the upper and lower bounds of the predicted macroscopic moduli which result from simplifying assumptions regarding stress or strain within a heterogeneous body. By comparing all available experimental data of the elastic moduli of oriented high polymer solids with the general theoretical curves, the possibilities and limitations of the concept of freely orienting microscopic elastic units are shown. Author

N68-10207 Waterloo Univ. (Ontario).
EXPERIMENTAL INVESTIGATION OF INTERSECTING SHELLS UNDER A SMALL EXTERNAL FORCE DISTURBANCE Final Report
N. C. Lind and S. Palusamy Sep. 1967 22 p refs Submitted for publication

The purpose of the investigation is to examine the influence of a small external moment or shear on the limit pressure of cylinder-to-sphere intersections (radial nozzles in spheres). Six steel models of different configurations were tested. Each model consists of a hemispherical shell spun out of hot rolled sheet conforming to AISI-1010 C to which a standard AISI-1010 C steel tube was welded. The cylindrical ends were closed by 1-1/4 inch thick plates of identical material. In order to economise the testing time and instrumentation, two such models of almost equal strength were welded together at the spherical boundary. Author

N68-10231*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME I: LATERAL VIBRATION MODES
G. B. Paddock Washington NASA Nov. 1967 86 p refs
(Contract NAS8-11486)
(NASA-CR-935; GD/C-DDF-65-001) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The lateral model development and modal calculations for a cylindrical space vehicle system and systems using clustered tanks are discussed along with the relative importance of physical characteristics and methods used to solve modal parameters. Emphasis is given to parameters important in control and stability analyses for which the system frequency of interest is generally below 20 cycles/second and quite often below 10 cycles/second. The general approach for dynamic solutions of these large systems is to develop a mathematical model describing the system's mass and structure, to calculate its normal modes of vibration, and, using normal mode theory, to apply the external forces and couple in the control system to obtain total response. The space vehicle in the lateral direction is represented by a series of lumped masses connected by elastic beams. By successive refinements, such as branch beams to include multiple load paths, concentrated masses attached to the beam by translational and rotational springs, or other possible independent structures or components, the model can simulate all significant motions. R.N.A.

N68-10233*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME IX: THE EFFECT OF LIFTOFF DYNAMICS ON LAUNCH VEHICLE STABILITY AND CONTROL
L. C. Engbrenghof Washington NASA Nov. 1967 30 p refs
(Contract NAS8-11486)
(NASA-CR-943; GD/C-BTD-67-031) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The analysis of liftoff dynamics concerns both rigid body and elastic motions of a rocket vehicle in the vicinity of the launch site. The analysis begins at engine ignition and ends when the vehicle clears all launch site facilities. Engine thrust, winds, launcher restraints, umbilical disconnects, and ducts are the forcing functions for the elastic and rigid body motions. Liftoff dynamics are analyzed to evaluate the possibility of a launching mishap, and to attain the highest value of launch availability (ratio of safe launch days over days in a given period) based on ground wind restrictions. The airborne system parameter variations used to solve liftoff dynamics problems include flight control system activation time, engine thrust vector angular alignment at liftoff, engine ignition sequence, and thrust buildup time histories. Launch site parameter variations used to solve liftoff dynamics problems include removal of nonessential hardware that might offer a flight path constraint, specification of acceptable retraction times for umbilical booms and other moving parts, and specification of force-time histories of launcher constraints. R.N.A.

N68-10238* Brown Engineering Co., Inc., Huntsville, Ala.
A METHOD OF STRESS ANALYSIS FOR SEMI-TOROIDAL TANKS, PART II
Murray F. Burnette 6 Nov. 1967 149 p refs
(Contract NAS8-20073)
(NASA-CR-61183) CSCL 20L

The linear membrane equations and hoop compression parameters are developed for semi-toroidal and modified ogival tanks. A general computer program for designing these tanks, the classification of toroidal loadings, and a summary of the state-of-the-art on toroidal shells are also included. Author

N68-10280*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME II: DETERMINATION OF LONGITUDINAL VIBRATION MODES
J. A. Staley Washington NASA Nov. 1967 65 p refs
(Contract NAS8-11486)
(NASA-CR-936; GD/C-BTD-67-053) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Elastic longitudinal models of multistage liquid and solid propellant vehicles, and vehicles with clustered tanks, are discussed, and methods are described for determining the dynamic characteristics needed for analyzing vehicle response and stability. The longitudinal model is considered to provide a mathematical representation of the real physical system, and the dynamic characteristics are determined from the mass, stiffness, and dynamic matrices. The equations for solution are formulated. The problems to be analyzed using longitudinal models include response to engine ignition and shutdown transients, release of a vehicle from its launcher, and the stability of engine-structure coupled oscillations. A second stability problem peculiar to liquid propellant vehicles with thin-skinned tanks involves coupling between structural motions and the tank pressure regulation system. It is pointed out that each of these problems may require different emphasis on details of the model used. M.G.J.

N68-10400# Witwatersrand Univ., Johannesburg (South Africa). Dept. of Mechanical Engineering.
ELASTO-PLASTICITY: A SELECT BIBLIOGRAPHY
Denise Blakely Smith, comp. Jul. 1967 30 p refs
(Rept.-42) CFSTI: HC $3.00/MF $0.65

A bibliography on elastoplasticity, taken from English language and other literature published primarily between 1950 and 1965, is arranged alphabetically by author. Most of the references are to journal articles, although some basic textbooks, reports of research institutes, and conference papers are included. Actually sources for this selected bibliography were the abstracts or entries contained in Engineering Abstracts, Industrial Arts Index, Applied Science and Technology Index, and Applied Mechanics Review. A limited subject index is included. M.W.R.

N68-10407*# Israel Program for Scientific Translations, Ltd., Jerusalem.
RIB-REINFORCED PLATES AND SHELLS
G. N. Savin and N. P. Fleishman 1967 342 p refs Transl. into ENGLISH of the Publ. "Plastinki i Obolochki s Rebrami Zhestkosti" Kiev, Nauk. Dumka, 1964 Prepared for NASA and NSF
(NASA-TT-F-427; TT-67-51364) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Theoretical and analytical data are presented on the stress concentrations in plates and shells reinforced by stiffening ribs. The general theory of bending of thin plates is reviewed, and the fundamental differential equation and representation of the general solution are given. Detailed consideration is given to such problems as bending of thin plates reinforced by curved stiffening ribs; bending of thin plates with reinforced edges; plates reinforced by very thin ribs; inverse problems of plates with holes whose edges are reinforced by thin ribs; and shells with stiffening ribs. The most important results referring to the interaction between stiffening ribs and plates or shells are given as simple formulas, graphs, and tables. The data provided are discussed from the viewpoint of efficient design of the reinforcing elements, and the optimum structure of thin plates and shells with ribs. M.G.J.

N68-10448* Bell Aerosystems Co., Buffalo, N. Y.
ALUMINUM APOLLO CONFIGURATION RCS PROPELLANT TANK SHELL. Final Report, Oct. 1965–Dec. 1966
Oct. 1967 71 p
(Contract NAS9-5330)
(NASA-CR-65803; D-2312-950001) CSCL 22B

As a result of the minimum development tests which were conducted as part of this program, it has been shown that flight weight 6061T6 aluminum alloy tank shells may be designed and fabricated. These tanks are functionally and dimensionally interchangeable with the Apollo (titanium) oxidizer tank shell and will meet the internal (positive) pressure requirements and be capable of withstanding, without collapse, complete (vacuum) evacuation. For complete qualification for flight, however, a limited design, fabrication, and test program which includes vibration tests with propellants or simulated propellants is recommended. For the Apollo Service Module and Command Module RCS tanks, a complete program would include a test of at least one of each type of tank shell. An appendix, which follows, outlines a program for a Flight Qualification Tank program. Author

N68-10451# Barry Controls Div., Barry Wright Corp., Watertown, Mass.
NEW DESIGN TECHNIQUES FOR DAMPING STRUCTURAL RESONANCES
Jerome E. Ruzicka [1960] 55 p refs

This paper considers the important problem of resonant vibration control in designing structures to function in modern dynamic environments. The disadvantages of some current design practices are outlined and the use of special structural designs which incorporate a high degree of damping is suggested as a solution to the problem. Methods for specifying structural damping are given and damping properties of engineering materials are reviewed. New highly-damped structural designs using viscoelastic damping materials are disclosed. The general dynamic characteristics of the viscoelastic-damped structures are discussed and experimental results are given for damped-sheet and structural shape members as well as for the strip-damper (an additive damping technique). Improved reliability and increased fatigue life are significant end results derived from the application of the new structural design techniques. Author

N68-10486# Israel Inst. of Tech., Haifa. Material Mechanics Lab.
CONSTITUTIVE EQUATIONS FOR DYNAMIC MATERIAL BEHAVIOR
S. R. Bodner Sep. 1967 35 p refs
(Contract AF 61(052)-951)
(MML-10; AFOSR-67-2311; SR-7; AD-659369)

The constitutive equations that have been developed for the dynamic behavior of materials presuppose the existence of a reference static yield criterion. An alternative formulation motivated by the work on dislocation dynamics considers the total deformation to consist of elastic and plastic components throughout the deformation history. This procedure permits the consideration of large deformations (finite strains) in a direct manner. The present

paper outlines an elastic-viscoplastic theory based on this approach and includes numerical results for an internally pressurized thick walled sphere. Author (TAB)

N68-10568*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME III: TORSIONAL VIBRATION MODES
R. Gieseke, R. Schuett, and D. Lukens Washington NASA Nov. 1967 63 p refs
(Contract NAS8-11486)
(NASA-CR-937; GD/C-DDF65-003, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This monograph discusses the torsional model development and modal calculations for the cylindrical space vehicle system and also systems employing clustered tanks. Relative importance of physical characteristics is discussed as well as methods used by the industry for the solution of modal parameters. Primary attention is focused on parameters important in control and stability analyses for which the system frequency is generally below twenty cycles per second and quite often below ten cycles per second. Application for loads analysis follows the same principles outlined herein but may require more detailed representation in areas where loads or deflections can be critical. The models described are concerned with gross vehicle torsional motions and do not include the shell tangential deflection modes which do not contribute to gross vehicle control and stability. Related monographs describe lateral, longitudinal, and sloshing models. Stability and loads analytical methods using these models and modal parameters are also subjects of other monographs. Author

N68-10574*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME IV: FULL SCALE TESTING FOR FLIGHT CONTROL PARAMETERS
David R. Lukens Washington NASA Nov. 1967 50 p refs
(Contract NAS8-11486)
(NASA-CR-938; GDC-BTD-67-049) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This monograph on flight control testing is primarily concerned with the major thrust vector control system and its principal components. The types of data that can be determined from full-scale tests are: frequency response, deadbands, friction, nonlinearities, limits, and the effect of structural resonances. Control system test data are required because the response characteristics of the flight control system are influenced by the total system. Most flight control systems are sufficiently complicated and responsive as to require tests to verify performance. The underlying basis for all first-of-a-kind launch vehicle flight readiness assertions must be analytical in nature. The only reason that an analytical stability derivation can be used is based on the premise that the analytical model used in analysis and synthesis can be verified by tests. This requires that the flight control system be analyzed for several test configurations and that agreement between model and test be obtained for each configuration. Then and only then can the final design verification be performed with confidence. Author

N68-10577# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
NEUBER'S RULE APPLIED TO FATIGUE OF NOTCHED SPECIMENS Final Report, 1 Feb. 1966–30 Apr. 1967
T. H. Topper, R. M. Wetzel, and J. Morrow Philadelphia NAEC Jun. 1967 23 p refs
(Contract N156-46083)
(NAEC-ASL-1114; AD-659550) CFSTI: HC $3.00/MF $0.65

A method is presented for predicting the fatigue life of notched members from smooth specimen fatigue data. Inelastic behavior of the material at the notch root is treated using Neubers rule which states that the theoretical stress concentration factor is equal to the geometric mean of the actual stress and strain concentration factors. This provides indices of equal fatigue damage for notched and unnotched members. Experimental results for notched aluminum alloy plates subjected to one or two levels of completely reversed loading are compared with predictions based on these indices. Measured notched fatigue lives and lives predicted from smooth specimens agree within a factor of two. Author (TAB)

N68-10581# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
OPTIMAL DESIGN OF ELASTIC STRUCTURES FOR MAXIMUM STIFFNESS
N. C. Huang Sep. 1967 20 p refs
(Contract N00014-67-A-0109-0003)
(TR-14; AD-659702)

The purpose the paper was to establish a general theory of optimal design of elastic structures such that the structure with a given volume would have maximum stiffness. A sufficient condition of optimality was derived from the principle of minimum potential energy. This optimality condition was proven by the variational method to be a necessary one under the condition that the optimal structure has certain continuity and differentiability properties. Physical interpretations of the optimality condition were discussed for problems of beams, plates and trusses. An application of the theory was illustrated in a problem of optimal design of a simply supported circular plate under uniform pressure. Detailed description of the numerical procedure for the solution of the plate problem was presented. Author (TAB)

N68-10601# Southampton Univ. (England).
THE DAMPING OF BEAM VIBRATION BY ROTATIONAL DAMPING AT THE SUPPORTS Technical Report, 1 Jan.–30 Sep. 1964
Denys J. Mead and J. F. Wilby Wright-Patterson, AFB, Ohio AFML Aug. 1967 36 p refs
(Contract AF 61(052)-504)
(AFML-TR-67-233; Rept.-121; AD-659482)

If the edges of a plate are embedded in a visco-elastic material, flexural vibration of the plate is damped by virtue of the damping forces and couples exerted at its boundaries. This paper analyses and assesses the effectiveness of this form of artificial damping when applied to a uniform beam and compares it with the effectiveness of homogeneous damping layers applied throughout the length of the beam. The theory is developed for the linear flexural response of the uniform beam to uniform harmonic loading. Transverse displacements of the beam are prevented altogether while rotation is opposed by the linear elastic and damping couples from the embedding material. Explicit expressions are derived for the amplitudes of curvature at the centre of the beam and from these it is shown that there exist optimum values of the end constraint damping properties which will minimize the beam resonant response. Methods of estimating these optimum values are discussed. It is shown that different optimum values are required to give the maximum effective flexural loss factors of the beam. This greatest value may be of the order of 0.33. Comparison with the effectiveness of homogeneous layers shows that the edge-constraint damping mechanism is more effective than thin homogeneous layers, but much less effective than thick layers. Author (TAB)

N68-10602# Naval Research Lab., Washington, D. C.
EXPERIMENTAL TECHNIQUE FOR DETERMINING FIXED-BASE NATURAL FREQUENCIES OF STRUCTURES ON SINGLE NONRIGID ATTACHMENT POINTS
Gene M. Remmers and Henry C. Mayo 31 Aug. 1967 24 p refs
(NRL-MEMO-1800; AD-659473)

Experimental verification of a technique for determining fixed-base natural frequencies of structures mounted on a single non-rigid support is provided. The feasibility of this technique of frequency determination was explored by measurements on individual double cantilever beams while each was attached to a frame designed to simulate characteristics of shipboard mounting conditions. The beams fundamental frequencies were distributed throughout the frequency range normally considered in shock design and thus each beam simulated a different lightweight equipment-foundation system. Response was measured at the required locations with high sensitivity (acceleration) transducers and circuitry. Instrumentation normally employed for mechanical mobility measurements proved suitable in these vibration tests after modification to improve frequency stability and resolution. The scope of this experimental work is limited to the one-foundation problem. The two-foundation problem is expected to be the subject of future experimentation. Author (TAB)

N68-10641*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STUDY OF ATTACHMENT METHODS FOR ADVANCED SPACECRAFT THERMAL-CONTROL MATERIALS, PHASE I Summary Report
Norbert H. Kordsmeier, Jr. and O. B. Renalds Oct. 1967 76 p refs
(Contract NAS2-4252)
(NASA-CR-73149; LMSC-A908107, Vol. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Attachment methods for a thermal control composite system consisting of second-surface mirrors (optical solar reflectors) and multiple layer insulation, are discussed. The following problem areas: (1) second-surface mirrors to a substrate, (2) mirror substrate to multiple-layer insulation or vehicle, (3) multiple-layer insulation blankets, and (4) multiple-layer insulation to vehicle skin, were each investigated. The most feasible methods of securing the composite system to the vehicle skin were selected by studying each candidate in relation to environmental and handling constraints imposed by intended applications for the system. L.S.

N68-10684 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
GENERAL THEORY OF VIBRATIONS OF CYLINDRICAL TUBES. PART II: UNCOUPLED TORSIONAL VIBRATIONS OF CLOSED TUBES
A. V. Krishna Murty and C. V. Joga Rao Jan. 1967 45 p refs
(AE-156S, Pt. II) CFSTI: $3.00

The equations govering torsional vibrations of unstiffened cylindrical tubes have been presented. Methods proposed in Part I are illustrated by considering the torsional vibrations of doubly symmetric tubes. An exact solution of a simply supported tube with the boundary of the cross section given by $p = S/2\pi \cos 2\pi s/S$ is presented. A free–free tube of rectangular cross section is analysed by using first order approximation equations and the results are in good agreement with earlier work. Author

N68-10691# California Univ., Berkeley. Div. of Applied Mechanics.
FINITE DEFORMATIONS OF INCOMPRESSIBLE SIMPLE SOLIDS
M. M. Carroll Jul. 1967 49 p refs
(Contract Nonr-222(69))
(AM-67-6; AD-659187)

Exact solutions of several problems which involve finite deformations of homogeneous isotropic incompressible simple solids are obtained by the inverse method. The deformations involved include bending, stretching, shearing, torsion and both cylindrical and spherical inflation. The corresponding stresses are expressed in terms of the functionals which describe the material response to homogeneous plane deformations. The results obtained apply, in particular, to incompressible viscoelastic solids. Author (TAB)

N68-10712 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
GENERAL THEORY OF VIBRATIONS OF CYLINDRICAL TUBES. PART 3: UNCOUPLED FLEXURAL VIBRATIONS OF CLOSED TUBES
A. V. Krishna Murty and C. V. Joga Rao Jan. 1967 43 p refs
(AE-1575) CFSTI: HC $3.00

Flexural vibrational characteristics of unstiffened double symmetric cylindrical tubes were studied. Natural frequencies of a simply supported tube of rectangular cross-section were obtained by using first and second order approximation equations. Numerical results indicate that it is essential to consider second order approximation equations to study the flexural vibrational characteristics of doubly symmetric tubes. Author

N68-10735# Therm, Inc., Ithaca, N. Y.
PREDICTION OF SHIP SLAMMING LOADS: ON THE WATER IMPACT OF A CIRCULAR CYLINDER
Michael D. Greenberg May 1967 23 p refs
(Contract Nonr-5145(00))
(TAR-TR-6701; AD-659069)

A theoretical analysis is presented, for the calculation of the slamming pressure on a rigid two-dimensional circular cylinder. Important features of the theoretical model are: inclusion of the finite air density, incompressibility of the air and water, retention of the full nonlinear free-surface conditions, and the use of a continuous vortex sheet to represent the free surface and its image inside the cylinder. The analysis is reduced to a systematic numerical procedure, which is now being coded for solution on a digital computer. Author (TAB)

N68-10768 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
GENERAL THEORY OF VIBRATIONS OF CYLINDRICAL TUBES. PART 5: UNCOUPLED FLEXURAL VIBRATIONS OF OPEN TUBES
A. V. Krishna Murty and C. V. Joga Rao Feb. 1967 35 p refs
(AE-1595) CFSTI: HC $3.00

Based on the simplicity in satisfying free-edge boundary condition, open tubes vibrating in flexure mode are classified as type C and type D. Compared to type D tubes, type C tubes have relatively simpler free-edge boundary condition. An alternate formulation is developed for type D tubes in which the satisfaction in the free-edge condition is as simple and direct as in type C tubes. Analysis of type C tubes is very similar to that of closed tubes. The flexural vibration characteristics of a simply-supported lipped-I-section, which is a typical open tube of type D are analyzed. Author

N68-10771# Brown Univ., Providence, R. I. Div. of Engineering.
PLANE STRAIN DEFORMATION NEAR A CRACK TIP IN A POWER LAW HARDENING MATERIAL
J. R. Rice and G. F. Rosengren Jul. 1967 25 p refs
(Contract ARPA SD-86)
(ARPA-E49; AD-659300)

Crack tip strain singularities are investigated with the aid of an energy line integral exhibiting path independence for all contours surrounding a crack tip in a two dimensional deformation field of an elastic material (or elastic-plastic material treated by a deformation theory). It is argued that the product of stress and strain exhibits a singularity varying inversely with distance from the tip in all materials. Corresponding near crack tip stress and strain fields are obtained for the plane straining of an incompressible elastic-plastic material hardening according to a power law. A noteworthy feature of the solution is the rapid rise of triaxial stress concentration above the flow stress with increasing values of the hardening exponent. Results are presented graphically for a range of hardening exponents, and the interpretation of the solution is aided by a discussion of analogous results in the better understood anti-plane strain case. Author (TAB)

N68-10782 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
SOME PROBLEMS IN THE FLEXURE OF THIN RECTILINEAR PLATES
S. G. Sampath and A. Kameswara Rao 1966 75 p refs
(AE-112S) CFSTI: HC $3.00

Some problems in the analysis of flexure of thin rectilinear plates are considered. Biharmonic polar functions in real variables are applied with analytical procedures for the approximate satisfaction of boundary conditions. It is shown that one can establish the accuracy of solutions by using alternative locations for the origin of the coordinates and by applying different techniques for boundary condition satisfaction. For many problems, a method of Taylor expansion of errors in boundary conditions (by a polynomial expansion of the polar functions) is very simple and effective. Three interesting points in thin plate theory emerge from the investigations. As the number of sides is increased indefinitely, a simply supported regular polygonal plate in flexure retains its polygonal character (arising from sharp corners) and does not approach circular plate behavior. Contrary to previously expressed opinions, it is found that free–free corners do not by themselves create any difficulties in the analysis of plate flexure. Author

N68-10831# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
PROPAGATION OF ELASTIC AND PLASTIC STRAIN PULSES IN BOUNDED SOLIDS Final Report, 1 Sep. 1963–31 Aug. 1967
C. W. Curtis 31 Aug. 1967 24 p refs
(Grants DA-ARO(D)-31-124-G463; DA-ARO(D)-31-124-G729)
(AD-659422)

The primary problem was to determine how the strain pulse spreads out, or disperses for various conditions of loading and for materials with different mechanical properties. Attention was also given to the electric field which accompanies a strain pulse as it propagates through a metal. Author (TAB)

N68-10833# California Univ., Berkeley. Div. of Applied Mechanics.
RODS, PLATES AND SHELLS
A. E. Green, N. Lwas, and P. M. Naghdi Jul. 1967 41 p refs
(Contract Nonr-222(69))
(AM-67-8; AD-659188)

Non-linear thermodynamical theories of rods and shells are discussed using the three dimensional theory of classical continuum mechanics as a starting point. The three dimensional theory is reduced to a two dimensional theory for a shell, or plate, and a one dimensional theory for a rod by employing an exact expansion for the displacement but an approximation for the temperature. For elastic rods and shells a method of approximation is suggested which brings the respective theories into correspondence with those of Green and Laws and Green, Naghdi and Wainwright. Author (TAB)

N68-10867# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
RAPID TENSILE TESTS OF SIX INTERMEDIATE-GRADE STEEL REINFORCING BARS
James T. Ballard and James R. Hossley Sep. 1967 25 p
Revised *Its* Misc. Paper 1–837
(AD-659263)

The Air Force Weapons Laboratory initiated a study to investigate the efficiency of various types of devices and methods used to splice steel reinforcing bars. Since the Waterways Experiment Station was in the process of installing and evaluating the 500- and 200-kip loaders, a request was made for WES to determine what strain rates could be applied by the 500-kip loader. Several No. 18 bars and No. 9 bars were tested to failure. When operating the 500-kip loader at its maximum rate of strain, rates of approximately 0.020 in./in./sec were produced. Average yield strength of the tested bars was 58,000 psi. Author (TAB)

N68-10884# Southampton Univ. (England).
PREDICTION OF NATURAL FREQUENCIES AND NORMAL MODES OF SKIN-STRINGER PANEL ROWS Scientific Report, 1 Oct. 1965–31 Dec. 1966
Colin A. Mercer and Caroline Seavey Wright-Patterson AFB, Ohio AF Mater. Lab., Aug. 1967 40 p refs
(Contract AF 61(052)-862)
(AFML-TR-67-234; AD-659444)

A transfer matrix method for the prediction of natural frequencies and normal modes of a finite row of skin-stringer panels is developed. The method allows for non-uniform stringer spacing and for different characteristics of individual stringers. Several examples are presented. Author (TAB)

N68-10912 Technische Hochschule Hannover (West Germany).
ON THE THEORY OF ELASTIC TORSION OF A FULL CYLINDER AT FINITE DEFORMATIONS [BEITRAG ZUR THEORIE DER ELASTISCHEN TORSION DES VOLLZYLINDERS BEI ENDLICHEN FORMAENDERUNGEN]
Otto W. Wetzell (Ph.D. Thesis) 1965 91 p refs In GERMAN

Determined are the stresses and maximal cutting forces necessary during torsional stress forming of a compressible cylinder. A tensor-linear deformation law with a Cauchy–Green deformation factor is used to simplify the problem for compressible materials. It is shown that a compressible cylindrical rod is shortened during torsional strain, and an incompressible cylinder is somewhat lengthened. High plastic torsional stress in general has an elongating effect on the cylinder. Transl. by G.G.

N68-10919# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Mechanical Engineering.
TORSIONAL VIBRATIONS OF HOMOGENEOUS AND SANDWICH SPHERICAL CAPS AND CIRCULAR PLATES
Bernard Koplik and Yi-yuan Yu Jul. 1967 18 p refs
(Contract AF 49(638)-1290)
(AFOSR-67-1982; SR-9; AD-659491)

Torsional vibrations of spherical caps are investigated on the basis of equations including thickness-shear deformation. Secondary transverse shear effect on extensional motion and secondary inertia effect are explicitly shown to be negligibly small for both homogeneous and sandwich caps, when these secondary effects (but not the primary transverse shear effect) are neglected. The curvature effect also drops out, and the problem becomes coincident with that of torsional vibrations of circular plates. A degenerate solution of the equations of motion further leads to an interesting torsional thickness-shear mode, which is particularly important for sandwich caps and plates with free edges, in general, frequencies of torsional vibrations of spherical caps and circular plates are found to start at a much higher level than those of axisymmetric vibrations. Author (TAB)

N68-10968# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

CUMULATIVE FATIGUE DAMAGE UNDER CYCLIC STRAIN CONTROL

T. H. Topper, B. I. Sandor, and Jo Dean Morrow Philadelphia, Pa. Naval Air Eng. Center Jun. 1967 35 p refs

(Contract N156-46083)

(NAEC-ASL-1115; AD-659302)

Cyclic deformation resistance and fatigue damage accumulation are investigated using multiple level strain control. Data are reported for 2024-T4 and 7075-T6 aluminum alloys, aircraft quality SAE 4340 steel, and Titanium 811. Effects of cyclic strain level, sequence of straining, number of blocks, and mean stress are investigated. For combinations of relatively large cyclic strain ranges there is no mean stress present and damage summations based on completely reversed strain vs life plots are close to one. Tensile or compressive mean stresses may be induced when the cyclic strain sequence is from a high to a low level. Damage summations based on completely reversed strain vs life data are reduced if the mean stress is tensile and are generally increased if the mean stress is compressive. Author (TAB)

N68-11001*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

IMPACT ATTENUATION OF MANNED SPACECRAFT

John W. Kiker [1965] 37 p refs Presented to the Session on Final Phase Aerodyn. Deceleration, Minneapolis, Minn., 6 July 1965

(NASA-TM-X-60606) CSCL 22B

Landing impact attenuation systems, required on all manned spacecraft to reduce impact velocities to the level of human tolerance, presented several problems requiring specific design into the spacecraft itself. Some of the problems arose from certain basic landing criteria such as horizontal and vertical landing velocities, type of landing surface, attitude of the vehicle, weather conditions, and objective of the mission. Factors considered in choosing attenuation systems were weight, volume, terminal deceleration capability, and adpatability for use in either land or water impact. A detailed study relative to the efficiency, weight, and physical properties of various energy-absorbing materials was made and is reported. Impact systems for Mercury, Gemini, and Apollo spacecraft are detailed and illustrated. An impact attenuation system utilizing rockets and para-Sails is considered. The impact system and landing sequence for the Lunar Excursion Module (LEM) are described and illustrated. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-10008# Brookhaven National Lab., Upton, N. Y.

EFFECT OF SLIP RATIO ON THE CRUCIAL BOILING LENGTH IN TWO-PHASE INSTABILITY

Louis M. Shotkin Jun. 1967 16 p refs Presented at the Symp. on the Dyn. of Two Phase Flow, Eindhoven (Netherlands)

(BNL-11532; CONF-670912-2) CFSTI: HC $3.00/MF $0.65

The crucial boiling length, 1_C for a single channel is that position of the boiling boundary where the channel is least stable, or where the ratio of heat input to coolant flow rate, Q_0/G_0, is a minimum. The analytical relation between Q_0/G_0 and the rest of the channel parameters depends very much on the theoretical model used and, in particular, on the empirical form of the slip ratio. A spatially-averaged model was used to compute 1_C [or rather $(Q_0/G_0)_{min}$] and to compare it with experimental results from several laboratories in the Q_0/G_0–δH plane. In doing this two empirical forms for the slip ratio were tested. Author (NSA)

N68-10009# General Dynamics Corp., San Diego, Calif. General Atomic Div.

THERMODYNAMICS OF ADSORPTION OF MIXED METALLIC ELEMENTS ON GRAPHITE AT HIGH TEMPERATURE

J. H. Norman, L. R. Zumwalt, and H. G. Stanley 5 May 1967 12 p refs Presented at the Symp. on Invest. on Thermodyn., Thermochem., and Transport Properties, Heidelberg, 12–14 Sep. 1967 Submitted for publication

(Contracts AT(04-3)-633; AT(04-3)-167)

(GA-7968; CONF-670913-2) CFSTI: HC $3.00/MF $0.65

Studies were made on the vaporization of Sr and Ba from TS-688 graphite and Ba from HLM-85 graphite using the Knudsen cell mass spectrometric method. Freundlich equations were derived for the studies. Attempts were made to describe a monolayer in three ways. The theory of mixed species behavior is also discussed. NSA

N68-10017* Avco Corp., Wilmington, Mass. Research and Technology Labs.

HEAT TRANSFER CALCULATIONS FOR HIGH SPEED REENTRY Final Report

W. Gibson, F. Czumak, A. Pallone, H. Buss, and E. Stein 8 Nov. 1967 95 p refs

(Contract NAS1-5786)

(NASA-CR-66471; AVSSD-0007-67-RR) CFSTI: $3.00 CSCL 20M

Heat transfer distributions are calculated for blunted cones reentering the earth's atmosphere at 50 and 45×10^3 ft/sec. The cone angles are 20, 40, and 45 degrees and the nominal nose radius is 1 foot. The dependence on nose radii between 1/10 of a foot and 5 feet is examined for a particular flight condition. Altitudes of 200 and 175×10^3 ft are considered. The heat shield material is a carbon-phenolic composite. The results demonstrate the variation of heat transfer with body shape, velocity, and altitude. Temperature profiles within the heat shield are also determined. Author

N68-10031*# Aerotherm Corp., Palo Alto, Calif.
EXPERIMENTAL AND THEORETICAL ANALYSIS OF ABLATIVE MATERIAL RESPONSE IN A LIQUID-PROPELLANT ROCKET ENGINE Final Report
Roald A. Rindal, Kimble J. Clark, Carl B. Moyer, and Donald T. Flood 1 Sep. 1967 223 p refs
(Contract NAS3-7945)
(NASA-CR-72301; Rept.-67-15) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Ablative material performance in a nitrogen tetroxide–aerozine rocket engine is investigated experimentally and theoretically. Ablation simulation experiments are conducted in an arc-plasma device designed to duplicate the primary aerothermochemical parameters. Computerized computational techniques are developed for mathematically modeling material degradation phenomena giving consideration to equilibrium and kinetically controlled chemical reactions at the char surface, and to liquid-layer removal from silica-reinforced materials. These techniques are employed to correlate the ablation simulation data and to predict ablative material performance in a liquid-propellant rocket engine. Predicted surface recession for the rocket engine throat was significantly greater than measured for each of six ablative materials considered. Local oxidizer-to-fuel mixture ratio variations can have a significant effect upon predicted ablation and represent a logical explanation for lack of agreement between predicted and measured surface recession. An approach for investigating the effect of local mixture ratio variation on surface recession is recommended. Author

N68-10040# Forsvarets Forskningsanstalt, Stockholm (Sweden).
CRYOGENIC TEMPERATURE SYSTEMS FOR ELECTRONIC INSTRUMENT APPLICATIONS [KYLSYSTEM FOER KYLNING INOM KRYOGENA OMRADET MED SPECIELL TILLAEMPNING VID ELEKTRONISKA INSTRUMENT]
G. Florin Apr. 1967 15 p refs In SWEDISH
(FOA-2-2480-51)

A survey is given on different processes and methods used as cryogenic heat sinks. Data and details on design and construction are summarized. Author (NSA)

N68-10043# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Central Engineering Group.
HEAT TRANSFER THROUGH LOW PRESSURE HELIUM GAS AT TEMPERATURES BELOW 4.2°K
D. C. Pickles and B. Colyer Mar. 1967 9 p refs
(RHEL/R-145) CFSTI: HC$3.00/MF$0.65

Experiments on heat transfer through low-pressure helium gas at liquid helium temperatures were performed. The experimental method is described and the results are discussed. It is shown that heat transfer is primarily by conduction. Author

N68-10081* Oklahoma State Univ., Stillwater. School of Mechanical Engineering.
[RESEARCH ON A SELF-TEMPERATURE REGULATING SPACECRAFT SKIN SYSTEM] Final Report, 1 Dec. 1966–31 Jul. 1967
J. A. Wiebelt Jul. 1967 37 p refs
(Grant NsG-454)
(NASA-CR-89989) CFSTI: $3.00 CSCL 20M

The feasibility of using thermostatic elements external to the spacecraft as thermal control units was studied. Original concepts of this system were reduced to a thermostatic fin arrangement. This basic geometric arrangement was analyzed and then received limited testing for evaluation. The basic geometry and possible configuration are discussed. A computer program was prepared which should be useful in the design of thermostatic fin systems. This program and a users instruction are included. A discussion of the limited experimental efforts is given. Author

N68-10100 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Raketentreibstoffe.
EMPIRICAL LAWS FOR HYBRID COMBUSTION OF LITHIUMHYDRIDE WITH FLUORINE IN SMALL ROCKET ENGINES [EMPIRISCHE GESETZE BEIM LITHERGOLEN ABBRAND VON LITHIUMHYDRID MIT FLUOR IN KLEINEN RAKETENBRENNKAMMERN]
Roger Lo Sep. 1967 50 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-57; DVL-673)

Combustion studies of lithium hydride with fluorine resulted in the development of empirical time dependent laws for various parameters of importance for the development of rocket engines with these propellants. Author

N68-10112# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
MASS SPECTROMETRIC STUDIES OF IMPURITY IONIZATION IN SHOCK-HEATED ARGON
B. Sturtevant and C. P. Wang *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 593–606 refs (See N68-10107 01-12)

Ionization kinetics of impurities in shock-heated argon using a sampling mass spectrometer were studied. The ions produced by thermal ionization in the early stages of the relaxation process behind a reflected shock wave were extracted from the shock tube through a small orifice in the end wall after they had diffused through the dense thermal layer adjacent to the wall. The ion diffusion was analyzed in detail to assess the possibility that the sampling process alters reaction products. In shock-heated argon contaminated with about 50 ppm of naturally occurring impurities, at temperatures between 10,500 and 14,300°K, a surprisingly large number of different ions are produced during the initial stages of ionization, but that O^+ and H^+ predominate. Consistent with the large rates, the ionization of H and O_2 which are thought to be coupled, approach equilibrium early in the relaxation process. The activation energy for ionization of H is about 10 eV and its effective cross-section is about 10^3 times larger than the inelastic cross-section for argon. Author

N68-10116# United Aircraft Corp., East Hartford, Conn.
APPLICABILITY OF SUDDEN-FREEZING CRITERIA IN ANALYSIS OF CHEMICALLY COMPLEX ROCKET NOZZLE EXPANSIONS
W. G. Burwell, V. J. Sarli, and T. F. Zupnik *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 701–759 refs (See N68-10107 01-12)

Several procedures for predicting the nonequilibrium flow properties and specific impulse performance of rocket expansion nozzles are discussed, including forms of sudden-freezing criteria and two exact numerical procedures for solving simultaneously the chemical kinetic and gas dynamic equations pertinent to the nozzle expansion process. With an exact procedures process, nonequilibrium property variations are determined in an axial direction along the length of an expansion nozzle. With an exact procedure to describe two-dimensional or axisymmetric supersonic kinetic flow fields, nonequilibrium flow properties are determined both along and transverse to the nozzle axis. Results obtained with the approximate and the exact one-dimensional kinetic flow procedures

are discussed. Information is presented for three representative propellant systems, namely H_2–O_2, H_2–F_2, and N_2H_4/UDMH–N_2O_4. Based on the effect of oxidizer-fuel mixture strength and operating chamber pressure on the nonequilibrium flow properties, the extent of equilibrium performance degradation due to chemical kinetic effects is determined. Author

N68-10117# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).
MEASUREMENTS OF RELAXATION EFFECTS IN NOZZLE FLOW OF HOT COMBUSTION GASES BY MEANS OF A SHOCK TUBE TECHNIQUE II
Th. Just and H. Pippert *In* AGARD Recent Advances in Aerothermochem., V. 2 1967 p 761–776 refs (See N68-10107 01-12)

Chemical relaxation effects were investigated by measuring temperatures at various positions along different nozzles. The required high inlet temperatures (3000–3500°K) were produced using shock driven detonations; and with a modified line reversal method, temperatures between 1800–3500°K were measured. For temperatures of 3100–3400°K at the nozzle entrance the background emitter was a stabilized carbon arc. The lower temperatures were measured with tungsten filament lamps. Nozzle geometry was varied, and its influence on the temperature distribution along the nozzles was studied using stoichiometric fuel–air mixtures and mixtures containing oxygen. The average mass flow rate through the nozzles was of the order of 1 kg/sec. Author

N68-10130 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THE NUMERICAL SOLUTION OF ELLIPTIC EQUATIONS FOR TRANSPORT OF VORTICITY, HEAT AND MATTER IN TWO-DIMENSIONAL FLOWS
A. K. Runchal, D. B. Spalding, and M. Wolfshtein Aug. 1967 44 p refs
(SF/TN/2)

A finite-difference method is presented for the solution of the elliptic differential equations for the steady transport of momentum, heat, and matter in two-dimensional domains. Special features of the method include: an unsymmetrical formulation for the convection terms, which promotes convergence; obedience to the conservation equations for all sub-domains; the use of grids having non-uniform mesh; and a novel treatment of the boundary condition for vorticity. Solutions are presented for the flow and heat transfer inside a square cavity with a moving top, and an impinging jet. It is shown that results may be obtained for very high Reynolds numbers (e.g. 10^6), even with coarse-meshed grids. The accuracy, convergence, and computation speed appear to be satisfactory for many purposes. Author

N68-10145# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALUMINUM AS A HIGH-TEMPERATURE HEAT-TRANSFER AGENT [ALYUMINIY KAK VYSOKOTEMPERATURNYY TEPLONOSITEL]
S. S. Filimonov, M. G. Kryukova, and S. V. Teplov 18 Aug. 1967 32 p refs Transl. into ENGLISH from the publ. "Teploobmen v Elemtakh Energeticheskikh Ustanovok" USSR, Izd-Vo Nauka, 1966 p 68–83
(FTD-MT-67-49; TT-67-62998; AD-659315)

The work considers increasing power plant economy and reducing heat-exchanger size through the use of aluminum as the heat-transfer agent. The physical characteristics of aluminum are given and discussed. The advantages of impurities of certain metals in aluminum, the reactions of aluminum at high temperatures (720-1200 C), and the disadvantages of high chemical activity, are discussed and compared with the thermophysical properties of the alkali metals. The use of graphite as the structural material to be in contact with liquid aluminum is proposed for direct thermal-to-electric energy conversion and in atomic reactors. An experimental installation developed at the G. M. Krzhizhanovskiy Power Engineering Institute is described and evaluated. The thermophysical characteristics of A1 and using graphites as the structural material permit considering aluminum a prospective heat-transfer agent for application in solving a number of problems. The difficulties in the way of practical use of aluminum as a heat-transfer agent can be successfully surmounted. Heat exchange during motion of liquid aluminum in pipes can be calculated by equations that are correct for calculation of heat exchange of other liquid-metal heat-transfer agents. Author (TAB)

N68-10154# General Dynamics Corp., Groton, Conn. Electric Boat Div.
OIL CONTAMINATION IN OXYGEN SYSTEMS Final Report, Jul. 1966–May 1967
John B. Presti and Charles J. De Simone, Jr. 16 Jun. 1967 68 p refs
(Contract NObs-94416)
(U413-67-101; AD-656126)

A test program was conducted to determine the ignition limits of oil contamination in 1/2 in. Monel pipe when pressurized with 3000 psi oxygen. The oils investigated were 2190 lubricating oil and Habcool no. 318 cutting oil. The test results showed little danger of compression ignitions at oil concentrations below 160 mg./sq ft of 2190, or below 110 mg./sq ft for Habcool. Concentrations of both oils above 260 mg./sq ft will ignite when rapidly pressurized with 3000 psi oxygen. The results also showed that ignition will not occur with oil droplets or puddles smaller than 100 microl in size and that a pressure rise greater than 25% will not occur below oil concentrations of 500 mg./sq ft. As a result of this test program, it is recommended that the oxygen clean standards be relaxed to 1.5 mg./sq ft. TAB

N68-10170*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
AN INVESTIGATION OF NEAR CRITICAL AND SUPER-CRITICAL BURNING OF FUEL DROPLETS Annual Report
G. M. Faeth, D. P. Dominicis, and D. R. Olson 30 Sep. 1967 35 p refs
(Grant NGR-39-009-077)
(NASA-CR-72314; AR-1) CFSTI: $3.00 CSCL 21B

This report presents some preliminary data from an apparatus developed to study the burning of fuel droplets at high pressures. For the tests, the droplet is supported from a quartz fiber or a thermocouple, contained within a small pressurized chamber. To prevent the droplet from falling from its support at high pressures, due to reduced surface tension, the experiment is carried out under zero-gravity conditions. Combustion lifetimes and droplet temperature measurements are reported over a pressure range from 14.2 to 2000 psia for n-decane and n-hexadecane burning in air. This pressure range allowed observations of super-critical droplet combustion. Author

N68-10178*# Mississippi State Univ., State College. Dept. of Mechanical Engineering.
VIBRATION EFFECTS ON HEAT TRANSFER IN CRYOGENIC SYSTEMS Quarterly Progress Report, Jul. 1–Sep. 30, 1967

C. T. Carley, C. J. Bell, T. T. Crow, R. E. Forbes, G. V. Smith et al 30 Sep. 1967 43 p
(Contract NAS8-20284)
(NASA-CR-89959; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The accumulation of data using water as the test fluid for the cell was started. After solving some routine apparatus and instrumentation problems, a total of 42 data points was recorded which are considered to be the primary information taken from the system since they show directly the effect of mechanical vibration on convective heat transfer in an enclosure. Temperature profile data from the traversing thermocouples, and data from the flow visualization apparatus were also recorded. The design of a liquid nitrogen test system was completed, and several of the major components were constructed. L.S.

N68-10280# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PROPERTIES OF INDIVIDUAL SUBSTANCES. VOLUME II: CALCULATION OF THE THERMODYNAMIC PROPERTIES
A. V. Gurvich, G. A. Khachkuruzov et al 13 Mar. 1967 868 p Transl. into ENGLISH from the book "Termodinamicheskiye Svoystva Individual'nykh Veschestv; v Dvukh Tomakh, Tom I; Vychisleniye Termodinamicheskikh Svoystv" Moscow, Izd-Vo an SSSR, 1962 p 856–1789
(FTD-HT-66-251, V. 2; TT-67-63062; AD-659660)

Methods of calculating the thermodynamic properties of individual substances are described, and critical analysis is given of the literature data until 1960, including the constants necessary for the calculation of the tables of the thermodynamic properties (molecular constants, heats of formation and heats of phase transitions, specific heats, dissociation energies, etc.). The choice of the values of these constants accepted in the Handbook is substantiated and their values are estimated for such cases where experimental data are lacking. The first part of Volume 1 covers the following elements, their compounds and, in some cases, their isotopes: O, H, F, Cl, Br, I, S, N, and P. TAB

N68-10274# California Univ., Berkeley. Aeronautical Sciences Div.
HEAT CONDUCTION IN A RAREFIED GAS BETWEEN CONCENTRIC CYLINDERS
Chic-lan Su (Ph.D. Thesis) Aug. 1967 93 p refs
(Contract Nonr-222(45))
(AS-67-15; AD-659317)

Heat conduction through a rarefied gas contained between concentric cylinders is studied analytically. Emphasis is placed on the connection with the experimental determination of thermal accommodation coefficients by the low-pressure method. The linearized BGKW-model equation is used, and the linearization procedure based on small relative temperature difference is justified. Two coupled linear integral equations of the perturbed temperature and density are then formulated. A variational principle for the heat flux is found for arbitrary Knudsen number. An asymptotic analysis is carried out for the case of mean free path much greater than the inner but of the same order as the outer cylinder radius, which corresponds to typical operating conditions of the experiment mentioned above. The lowest order deviation of the heat flux from its free-molecular value is of O(ln(Kn)/Kn) and is the same as that obtained by the Knudsen iteration method. Numerical calculations are performed to find the next order correction term. It is found that for mean free path 20 or more times the inner cylinder radius the relative error introduced by using the free-molecular value for the heat flux is less than 5%, provided that the ratio of the mean free path over the outer cylinder radius is at least 0.2.
Author (TAB)

N68-10287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PROPERTIES OF INDIVIDUAL SUBSTANCES. VOLUME I: CALCULATION OF THE THERMODYNAMIC PROPERTIES. (CHAPTERS 1 THRU 15) [TERMODINAMICHESKIYE SVOYSTVA INDIVIDUAL'NYKH VESHCHESTV. TOM PERVYY: VYCHISLENIYE TERMODINAMICHESKIKH SVOYSTV]
A. V. Gurvich, G. A. Khachkuruzov, V. A. Medvedev, I. V. Veyts, G. A. Bergman et al 13 Mar. 1967 940 p refs Transl. into ENGLISH from Izd. Akad. Nauk SSSR (Moscow), 1962 1033 p
(FTD-HT-66-251, Vol. I, Pt. I; TT-67-63067; AD-659659)

Methods of calculating the thermodynamic properties of individual substances are described, and critical analysis is given of the literature data until 1960, including the constants necessary for the calculation of the tables of the thermodynamic properties (molecular constants, heats of formation and heats of phase transitions, specific heats, dissociation energies, etc.). The choice of the values of these constants accepted in the Handbook is substantiated and their values are estimated for such cases where experimental data are lacking. This second part of Volume I covers the following elements and compounds: C, CH4, C2H6, C2H4, S, B, Al, Be, Mg, Ca, Sr, Ba. TAB

N68-10289*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL DESIGN VERIFICATION TESTING OF THE ANCHORED INTERPLANETARY MONITORING PLATFORM "D"
Jere W. Medlin, Jr. Washington NASA Nov. 1967 26 p refs
(NASA-TN-D-4112) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Major aspects of the thermal design performance test of the Anchored Interplanetary Monitoring Platform (AIMP-"D"-Lunar Orbiting) are presented herein. The severity of the test and the accuracy of the thermal predictions during the initial test phases are significant items. The test verified the assumptions made for the thermal model with minor exceptions. Thermal design was verified and the spacecraft successfully survived the 6.8-hour shadow simulation with only one experiment problem. Orbital thermal predictions and results are also presented. The orbital temperatures were generally within predicted values for most items with the exception of the solar paddles. The thermal test program was a success in closely duplicating the orbital thermal environment and in developing an excellent spacecraft thermal design. After completion of this report, orbital thermal data was received which exceeded predicted temperatures. Retro-motor exhaust contamination of the spacecraft top cover was determined by the thermal design engineer to be the cause of the thermal extremes.
Author

N68-10340# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THERMODYNAMICS OF LIQUID DIABATIC FLOW AND RELATED INSTABILITIES
G. Bosco 1967 67 p refs
(RT/ING-(67)2)

Problems regarding thermal and/or hydraulic instabilities, arising under severe operating conditions in nuclear reactor cores, cooled by non-saturated liquids, require being correctly solved and interpreted on the basis of thermodynamic theory, extended to visco-elastic fluids. The limiting conditions for stability in a nonadiabatic flow shows, inter alia, that burnout is associated with the onset and propagation of shock waves. In this context theoretical equations are derived for the critical heat flux which are in good agreement with predictions made when using empirical correlations.
Author (NSA)

N68-10368* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TRANSIENT CHILLDOWN OF A SINGLE THICK-WALLED TUBE BY LIQUID AND GASEOUS HYDROGEN

Francis C. Chenoweth, James J. Watt, and Earl L. Sprague Washington NASA Nov. 1967 55 p refs

(NASA-TN-D-4238) CSCL 20M

The flow and heat transfer characteristics during the startup of a nuclear rocket are of particular interest because of the bootstrap type of startup. An analytical procedure was assembled using state-of-the-art equations to provide a tool for predicting the transient flow and heat transfer characteristics of reactor components during the startup. The results of applying this analytical procedure to a single thick-walled tube, which was selected as typical of a passage in the reflector of a current nuclear reactor, are presented. Experiments were performed on a thick-walled tubular test section to provide experimental data for comparison with predicted results. With the test section at room temperature, either liquid-hydrogen or cold-hydrogen-gas flow was directed through the 3/16-inch (0.476-cm) bore of the 55-inch (139.6-cm) long test section until it was thoroughly chilled. During most of the liquid-hydrogen chilldown, a saturated liquid was assumed to be at the inlet of the test section. During the gas chilldown, the inlet gas temperature varied from 470° to 360°R (261° to 200°K). Inlet pressures ranged from 20 to 50 psia (1.38×10^5 to 3.45×10^5 N/m^2 abs). The initial wall temperatures and the flow rate, the inlet enthalpy, and the inlet pressure as functions of time from the experimental test were used as input for the analytical procedure. Comparison of predicted and experimental material temperatures, pressures, and exit temperatures indicated that, when cold hydrogen gas was used as the chilling medium, excellent agreement was obtained. When liquid hydrogen was used, only the average chilldown rates of the test section agreed. Local predicted material temperature variations were traced to characteristics of the heat transfer correlations used. Pressure and exit temperature variations were related to an extreme sensitivity of predicted values to variations in inlet quality and flow rate. Author

N68-10393# California Univ., Berkeley. Lawrence Radiation Lab.

A THERMODYNAMIC STUDY OF THE HEAT OF ORDERING IN Cu–Pt

Gerald Wayne Geiken (M.S. Thesis) Jun. 1967 20 p refs

(Contract W-7405-ENG-48)

(UCRL-17615) CFSTI: HC $3.00/MF $0.65

The heat of formation of the equiatomic Cu–Pt alloy was measured as a function of temperature over the range 360 to 1155°K by means of liquid tin solution calorimetry. The results showed that the heat of formation decreases from −4010 cal/g-atom at 360°K to −4140 cal/g-atom at 800°K, and then increases again to −3070 cal/g-atom at a critical temperature of about 1100°K, at which a latent heat absorption of 440 cal/g-atom occurs. The results were interpreted as due to a disordering of the alloy as it is heated. The total ordering energy of the alloy was 1510±100 cal/g-atom. Author (NSA)

N68-10401*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

MEASUREMENT OF THERMAL CONDUCTANCE OF MULTILAYER AND OTHER INSULATION MATERIALS Final Report

Erwin Fried, Gilbert S. Karp, Robert B. Hobbs, and Gerald Hieser 29 Sep. 1967 52 p refs

(Contract NAS9-3685)

(NASA-CR-65797; Doc.-67SD4388) CFSTI: HC $3.00/MF $0.65 CSCL 20M

To obtain thermal performance data on extravehicular spacesuit garment material, thermal conductance measurements were made on crinkled aluminized polyester films in vacuum. The number of film layers, which were separated by nonwoven Dacron, ranged from two to nine for a fixed sample thickness. An optimum insulation density of five to six layers was found for the low temperature case, and of seven to eight layers for the high temperature case. Thermal conductance evaluations on a parametric basis were conducted of NASA-furnished space suit assembly material samples. Significant variables were compression of the multilayer layups and boundary temperatures, which varied from −320°F to +285°F, with the body-side temperature held at about 70°F in all cases. The test data obtained for each space suit configuration are summarized in terms of compressed thickness, thermal conductivity, thermal conductance, chamber pressure, and electric power input. M.G.J.

N68-10416 Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

ON SOME ASPECTS OF FLASH DISTILLATION WITHOUT METALLIC INTERFACES

A. Kogan and M. Victor [1965] 22 p refs Sponsored by Israel Natl. Council for Res. and Develop.

(TAE-60)

The concentration profile of noncondensible gas above a condensation interface was investigated, and a sensitive method was developed for the measurement of noncondensible gas concentrations in a water gas atmosphere at low temperature. This method was applied to the measurement of noncondensible gas concentrations above the free surface of a cold horizontal water stream in a single-stage flash distillation cell. A steep concentration gradient near the condensation interface is found; and the specification of gas content close to the nozzle is not sufficient to make comparisons of condensation experiment results, which have in the past presented divergent views on the condensation factor. M.W.R.

N68-10438# Oak Ridge National Lab., Tenn.

THERMAL CONDUCTIVITIES OF ^{90}Sr HEAT SOURCE MATERIALS

E. E. Ketchen, and R. E. McHenry [1967] 13 p refs Presented at the 2d Intern. Symp. on Nucleonics in Aerospace, Columbus, Ohio

(Contract W-7405-ENG-26)

(ORNL-P-3203; CONF-670714-4) CFSTI: HC $3.00/MF $0.65

The thermal conductivities of SrO, Sr_2TiO_4, and $SrTiO_3$ (of a composition that simulates these compounds prepared from nuclear fission fuels waste) are reported. The thermal conductivities were measured using a comparator apparatus, which was altered to evaluate several factors necessary to establish a procedure for measurement of the thermal conductivities of radioactive heat source fuels. The errors in the reported values are assessed and a procedure for high-power-density radioactive samples is described. Author (NSA)

N68-10450 Maschinenfabrik Augsburg-Nurnberg A. G., Nuremberg (West Germany).

INVESTIGATIONS INTO THE CRITICAL HEAT FLUX IN BOILING WATER

F. Mayinger, O. Schad, and E. Weiss Brussels EURATOM Aug. 1967 357 p refs

(Contract EURATOM-057-61-9 RDD)

(EUR-3347.e; EURAEC-1811)

This work concerns the measurement of critical heat flux (burnout) in boiling water, and especially the influence of flow prehistory and inlet conditions together with the test-channel L/D

ratio on nucleate boiling and the onset of film boiling. The measurements were made at pressures of 70 to 140 atm on internal-flow tubes of diameter 0.7 to 1.5 cm. With mass-flows of between 100 and 350 g/cm^2/sec, the test-channel intake conditions ranged from 20% subcooling to 20% steam quality. Two physically quite distinct forms of burnout were observed. With the one form the pressure and mass-flow begin to fluctuate shortly before the onset of film-boiling; this form is therefore called "pulsating burnout". With the other form the hydrodynamic behavior is completely stable until film-boiling suddenly begins. Pulsating burnout, which was observed only in the subcooled boiling range, leads to critical heat flux values 20 to 50% below those for hydrodynamically stable flow. With hydrodynamically stable burnout it was sometimes possible to increase the burnout up to 80% by altering the inlet hydrodynamics (orifice plates or short swirl-vanes). Further, it was found that reduction of the L/D ratio affects the burnout during boiling even more than do these hydrodynamic modifications. Author

N68-10476# Joint Inst. for Nuclear Research, Dubna (USSR). Nuclear Problems Lab.

ON THE ION DETECTION IN THE SUPERCOOLED LIQUIDS [O VYYAVLENII IONOV V PEREOKHLAZHDENNYKH ZHIDKOSTYAKH]

A. F. Pisarev 1967 12 p refs In RUSSIAN
(JINR-PI-3360)

It is shown by means of thermodynamic calculations that nonpolar and weakly polar liquids as well as the liquids with isotropic electric polarizability must crystallize effectively on the ions or ion complexes in a supercooled state. The calculation of probability of crystal production on ions as nuclei in an impulse supercooled argon is given as an example. Author (NSA)

N68-10508*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THERMAL CONTACT CONDUCTANCE IN A VACUUM AND RELATED PARAMETER STUDY

Harry L. Atkins [1964] 51 p refs
(Contract NAS8-5207)
(NASA-TM-X-60588) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A thermal contact conductance apparatus, for use in a vacuum, was developed to permit accurate measurement of thermal conductance as a function of pressure. Cylindrical columns were used to minimize flatness deviations under load. To insure accuracy, attention was focused on accurate temperature and surface finish measurement techniques. Samples of stainless steel, and magnesium, aluminum, and copper alloys were tested. Generally, it was observed that when conductance versus pressure is plotted on log–log paper a curve results which indicates a definite two-regime elastic behavior with a pronounced point of change in slope. Deformation experiments were performed on three models, and data are given on the deformed area and height of the models as a function of applied load. M.G.J.

N68-10539# Saab Aircraft Co., Linkoping (Sweden).

SEMI-DISCRETIZED TREATMENT OF THE EQUATION OF CONDUCTION OF HEAT IN SOLIDS. ONE-DIMENSIONAL LINEAR FLOW OF HEAT

Hermann Behrbohm Sep. 1967 81 p refs
(SAAB-TN-63)

The partial differential equation governing the one-dimensional conduction of heat in solids is semi-discretized by discretizing the space coordinate only, leaving time as a continuous variable. The complete and explicit solution is given for the system of ordinary differential equations into which the partial differential equation of conduction of heat is split by discretizing the slab of finite length into an arbitrary number of subintervals of equal length. Arbitrary temperatures, or fluxes of heat across the boundaries, or linear combinations of both, at the ends of the slab and variable with time, arbitrary initial temperatures along the slab, and arbitrary inner heat sources variable both in space and time, may be prescribed. The chosen system in toto, i.e. differential equation including the boundary conditions, is an approximation of the order $O((\Delta x)^2)$, where Δx is the width of the space meshes. The eigenvalues of the first, the second, and the mixed boundary value problem can be explicitly given. The eigenvalues of the third boundary value problem depending, of course, on the coefficients of surface heat transfer have, however, to be calculated numerically. Comparisons are made between analytic solutions of the semi-discretized system of approximating equations and analytic solutions of the exact equation of conduction of heat in solids, showing the high approximating qualities of the semi-discretization method. Author

N68-10588# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

COUPLED RADIATION AND CONDUCTION IN FREE MIXING

Pasquale M. Sforza and Lawrence D. Porter Jul. 1967 34 p refs
(Contract Nonr-839(34))
(PIBAL-1005; AD-659475)

Heat transfer by both grey radiation and conduction is examined in the case of Oseen-like free-mixing flow which is formally analogous to a one-dimensional unsteady transfer problem. The equation describing the transport of energy by non-convective means is obtained by linearization of the conservation of energy relation. The geometry of the time-dependent problem may be envisaged as a slab of finite width separating two infinite half-spaces; this configuration is analogous to the steady, free-mixing flow of a two-dimensional jet or wake. The initial temperature profile of the jet with respect to the surrounding gas is taken to be a step function. By means of the transform calculus the determination of the temperature for the entire region of the jet and the fluid adjacent to it may be given as an inversion integral. This approach does not require a kernel substitution in the solution of the integro-differential equation for the temperature and thus avoids some of the limitations imposed thereby. Analytic solutions in the limiting cases of thin and thick gas behavior are readily recovered from the general solution. From the bounded variation of the integrand the temperature distribution may be computed for all possible combinations of the heat conduction and radiation parameters. Exact numerical evaluation of the inversion integral is employed to provide a complete description of the temperature variations in the flow. Author (TAB)

N68-10626*# LTV Aerospace Corp., Dallas, Tex. Astronautics Div.

EXPLICIT FINITE DIFFERENCE HEAT TRANSFER PROGRAM LVVM 25

J. L. Gaddis 29 Jul. 1966 120 p refs
(Contract NAS9-2772)
(NASA-CR-65742; TR-00.832) CFSTI: $3.00 CSCL 20M

This report describes analytical methods, user's instructions and data preparation guide, and a sample problem for a generalized heat transfer computer routine. The routine is capable of analysis of conduction, radiation to space, and convection from internal flow. It is particularly suited for the analysis of space radiators and general thermal control fluid loops. Transient thermal analysis is performed using an explicit finite difference method. Flow analysis of internal flow in general fluid networks is performed in accordance with pressure drop phenomena. The flow may either (1) be balanced

to give equal pressure drop in parallel portions of a circuit with or without the total flow determined for a specific pump or (2) be prescribed in individual tubes to aid in post-test correlation. Author

N68-10627*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.

A STUDY OF THE SUPPRESSION OF COMBUSTION OSCILLATIONS WITH MECHANICAL DAMPING DEVICES Final Report, 1 Jul. 1966–30 Sep. 1967

20 Nov. 1967 87 p refs

(Contract NAS8-11038)

(NASA-CR-90094; PWA-FR-2596) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The objectives of work conducted were: to determine the effects on liner absorption of simultaneous gas flows through and past the apertures, to investigate methods of improving the bandwidth characteristics of absorbing liners, and to determine the effects on absorption of differences in gas properties between the liner apertures and the combustion chamber. An impedance tube modified with flow ducts was used to measure the increase in linear acoustic resistance with flow; correlations of data with both flow velocity and Mach number are presented. Six different liner assemblies were evaluated in the bandwidth experiments. Theoretical analyses were made of the two assemblies that produced the greatest bandwidth improvement. A pressure-phase impedance measuring device was used in the gas property experiments; from the results it was concluded that the effects on sound intensity of a change in the medium through which a sound wave must travel can be predicted from one-dimensional theory. In addition, a standard impedance tube driven by a high-intensity electropneumatic transducer was used to measure the acoustic resistance of Helmholtz-type resonator arrays at incident sound pressure levels in the nonlinear regime. A simple correlation of the nonlinear resistance factor with sound pressure was obtained. Author

N68-10662 Saab Aircraft Co., Linkoping (Sweden).

CALCULATION OF THE TEMPERATURE DISTRIBUTION FOR AN ELLIPTIC CYLINDER WITH GIVEN HEAT FLUX ACROSS THE SURFACE

Bert Arlinger [1967] 40 p refs

(SAAB-TN-62)

The problem of predicting the temperature distribution in two-dimensional blunt bodies, as, for instance, in solid leading edges of wings at high speed of flight, motivates calculation of the non-stationary temperature distirubtion within an ellipse with a given heat flux (variable along the boundary) as boundary conditions. This heat flux, which is suddenly applied at time zero, is time-independent. (The solution for the time-dependent case can easily be derived from that for the time-independent case with the aid of Duhamel's integral). The solution is given as the sum of three partial solutions: the first is a simple expression in the time and space coordinates (linear in time), the second is a Fourier series in the space coordinates and the third, the transient part, is a sum of exponential functions of time where the coefficients are Mathieu-functions in space. The non-transient part of the solution has been calculated for a family of ellipses with different eccentricities and is also given as series expansions around the two limiting cases with eccentricities zero and one, respectively. The transient phase has also been calculated for these limiting cases and by means of these its extent in time can be estimated for a general case. Author

N68-10732# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A THIN PROFILE OF A SUPERSONIC WING WITH MINIMUM AVERAGE HEAT TRANSFER COEFFICIENT AT GIVEN AERODYNAMIC CHARACTERISTICS [TONKIY PROFIL' SVERKHZVUKOVOGO KRYLA S MINIMAL'NYM SREDNIM KOYEFFITSIYENTOM TEPLOOTDACHI PRI ZADANNYKH AYERODINAMICHESKIKH KHARAKTERISTIKAKH]

M. B. Polyakov and Y. A. Shcherbak 20 Apr. 1967 18 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tech. (Kazan), no. 4, 1965 p 51–61

(FTD-HT-66-491; TT-67-62990; AD-659272)

The paper deals with the problem of determining the optimum shape of a supersonic wing with a given aerodynamic characteristics (lift, total darg, liftdrag ratio, etc.) which minimizes the average heat-transfer coefficient. The problem is reduced to determining the function Y = Y(X) of the characteristic line of a thin profile which ensures the extremum of the functional of the average heat-transfer coefficient at given values of drag coefficients. This isoperimetric variational problem is solved by using indeterminate Lagrange multipliers. The solution is presented for the case when lift and drag are given, from which the solutions of other particular problems may be obtained. It is assumed that the lower and upper surfaces of the thin profile are thermally insulated from each other and that the boundary layer is totally laminar or totally turbulent. The local heat-transfer coefficients on a slightly cambered profile were determined by substituting the local flow parameters in the formulas obtained for an isothermal 'plate' at zero angle of attack. Author (TAB)

N68-10777# Los Alamos Scientific Lab., N. Mex.

MEASUREMENT OF THERMAL CONDUCTIVITY AND ELECTRICAL RESISTANCE OF ZrC, HfC, NbC, AND TaC AT HIGH TEMPERATURES

V. L. Yupko, Yu. B. Paderno, I. G. Barantseva 1965 11 p refs Transl. into ENGLISH from Vysokotemperaturnye Neorganicheskie Soedineniya (USSR) 1965 p 199–204

(LA-TR-67-18) CFSTI: HC $3.00/MF $0.65

The thermal conductivity and the electrical resistance of ZrC, HfC, NbC, and TaC were determined in the 1370° to 3270°K range. The samples were 8 mm in diameter and 15 to 18 mm in length. The hole depths were 3.5 to 3.7 and 1.8 to 2.0 ohm, their diameter was 0.9 mm, the distance separating them was approximately 5 mm, and the distance between the potential zones was 7 to 7.5 mm. The apparatus used for the measurements is diagrammed. The composition of the carbide samples is shown in a table. NSA

N68-10903# United Kingdom Atomic Energy Authority, Harwell (England).

EXPERIMENTAL INVESTIGATION OF DETERIORATION CONDITIONS OF HEAT TRANSFER IN FLOW OF STEAM AND WATER MIXTURE IN HEATED PIPES

A. S. Kon'kov 1966 18 p refs Transl. into ENGLISH from Tr. Tsent. Nauch.-Issled. Proekt.-Konstr. Kotloturbinnogo Inst., v. 58, 1965 p 170–178

(NP-tr-1522) CFSTI: HC $3.00/MF $0.65

The deterioration conditions of heat transfer in the flow of steam and water mixtures in heated pipes were investigated. The steam contents and maximum internal surface wall temperatures were determined experimentally. The investigation showed that the point at which heat exchange for various steam contents begins to deteriorate depends on the pressure, mass velocity, specific heat flux, and diameter of the pipe. A criterial equation for calculating the steam content at the point of heat transfer deterioration over a range of parameters is given. NSA

N68-10926# California Univ., Livermore. Lawrence Radiation Lab.
HIGH-TEMPERATURE PROPERTIES OF LIQUID METALS
J. L. Watts 21 Jul. 1967 61 p refs *Its* Space Power Note No. 227
(Contract W-7405-ENG-48)
(UCID-15176) CFSTI: HC $3.00/MF $0.65

A library search and parameter compilation was carried out in order to obtain the temperature dependent parameters of vapor pressure, vapor density, liquid density, heat of vaporization, surface tension, liquid viscosity, and vapor viscosity for the liquid metals Li, Na, K, Rb, Cs, and Ag over the vapor pressure range from 10^{-2} (10^{-3} for Cs) to 10 bar. Author (NSA)

N68-10940*# Southwest Research Inst., San Antonio, Tex.
LOX-CONTAINER-RUPTURE FIRE HAZARDS Final Report, Aug. 29–Oct. 16, 1967
W. D. Weatherford, Jr. 16 Oct. 1967 18 p refs
(Contract NAS9-7510)
(NASA-CR-65798) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Reported is a study designed to experimentally explore the fire hazard situation which could arise upon accidental rupture of a pressurized container of liquid or gaseous oxygen. Objectives of the study were: (1) to determine the effect of impingement of 1500 psia compressed oxygen gas and of 900 psia cryogenic supercritical oxygen against Mylar superinsulation in air at 15 psia; and (2) to include impingement in 6 psia air environment if combustion were initiated, and determine the threshold air environment pressure for combustion initiation by such impingement. Experiments involved: (1) the rapid ejection of cryogenic oxygen through an orifice by 900 and 1200 psi helium with target specimen located in ambient air 2-3/4 inches from the orifice; and (2) the rapid release of 1500 psi oxygen gas through a rupture disc fitting with target specimen located in ambient air 2-1/4 inches from the throat of the fitting. Results of impingement experiments revealed no combustion initiation for any of the following specimen tested: a Kapton-covered Mylar superinsulation blanket; Mylar superinsulation with the Kapton cover removed, the Kapton cover used alone, and the Velcro strip used alone. S.C.W.

N68-10943 United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
THERMAL CONDUCTIVITY OF POLYCRYSTALLINE GRAPHITE
R. Taylor, K. E. Gilchrist, and L. J. Poston 1967 14 p refs
(TRG-1437(C))

Measurements of thermal conductivity from 100–900°K and electrical resistivity at 80°K have been made on two mutually perpendicular directions of two types of anisotropic polycrystalline graphites and of two isotropic graphites of different densities. The thermal conductivity curves can be fitted using expressions calculated for thermal resistance due to boundary and isotope scattering and a relationship for Umklapp scattering derived from pyrolytic graphite. By invoking a factor to account for the reduction in conductivity due to porosity and irregular arrangement of crystallites in polycrystalline graphite, crystallite size values are obtained from thermal conductivity analysis. Crystallite sizes obtained from electrical resistivity measurements using the simple two-band model are about 0·4–0·5 those derived from thermal conductivity and various reasons are suggested to explain the difference. Author

N68-10946* Bureau of Mines, Pittsburgh, Pa.
HYPERGOLIC IGNITION AND COMBUSTION PHENOMENA IN THE PROPELLANT SYSTEM AEROZINE-50/N_2O_4 Final Report, Apr. 1, 1965–Mar. 31, 1967
Henry E. Perlee, Yael Miron, Harry James, and Theodore Christos
31 Mar. 1967 51 p refs
(NASA Order T-39882-G)
(NASA-CR-65794; FR-4019) CSCL 21B

A literature and industry survey and an experimental study were conducted on adverse hypergolic ignition phenomena. The survey was concerned with the various pressure spiking processes believed to occur during the initial period of engine start. These include manifold spiking, heterogeneous combustion, and condensed phase combustion. The experimental effort involved the combustion characteristics of the propellants individually and jointly, the identification of preignition reaction products, and the physical and combustion characteristics of these products in relation to their presence in the engines. The propellants used were hydrazine, monomethylhydrazine, unsymmetrical dimethylhydrazine, and Aerozine-50. The oxidant was nitrogen tetroxide. A brief discussion of some of the principles of combustion is included. The appendices deal with the physical and thermochemical properties of the various fuel nitrates, and the structural and inertial response of small engines to internal explosions. R.N.A.

N68-10963* Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
INVESTIGATION OF DESORPTION COOLING Final Report, Dec. 1, 1966–Jun. 15, 1967
John G. Daunt 15 Jun. 1967 45 p refs
(Grant NGR-31-003-043)
(NASA-CR-90224) CSCL 20M

Results are presented giving the performance of desorption cooling systems with various adsorbents. Using He^4 as the working gas and a variety of adsorbents, it was found that by desorption cooling the temperature could be reduced by a factor of two or more starting from temperatures below 20°K. Full details of the cooling process are given. Data are also presented for adsorption isotherms of He^4 on zeolite below 20°K. The results fully substantiate estimates of the performance of desorption cooling and indicate that the desorption cooling process may have wide and significant applications, particularly for space vehicles. Detailed recommendations are given for further work in order to establish complete engineering data for desorption cooling systems. A complete literature survey on desorption problems was carried out and the results are given. Author

N68-10987 Lockheed Missiles and Space Co., Palo Alto, Calif.
SELECTIONS FROM "BOUNDARY LAYERS WITH CHEMICAL REACTIONS"
B. V. Alekseev [1967] 25 p refs Transl. into ENGLISH from Vychisl. Tsentr. Akad. Nauk SSSR (Moscow), 1967 p 94–125

Computations are made of a laminar boundary layer with chemical reactions in the neighborhood of the stagnation point for a body of revolution. Consideration was given to the chemically nonequilibrium boundary layer for the case of oxygen flow around graphite. Comparisons are made of existing computations in the frozen and equilibrium boundary layer, and calculations were performed which took into account the finite rate of chemical reactions in the gas, on the surface, and in the pores of the body. The influence of various molecular models on the mass rate of entrainment of the body material was studied, and saturated carbon vapor pressure effects on the quantities characterizing the destruction of heat shields were investigated. C.T.C.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-10072* University of Southern Calif., Los Angeles. Western Research Application Center.
QUARTERLY REPORT, 15 MAY–15 AUGUST 1967
15 Aug. 1967 31 p
(Contract NSR-05-018-071)
(NASA-CR-90039) CSCL 05A

This is the third quarterly report on the establishment and operation of the Western Research Application Center (WESRAC). Prior periods were devoted primarily to staffing, preparation of facilities by the University, and the acquisition of equipment for operation and basic files from which service could be provided to NASA technology users in the West. This report is concerned primarily with events occurring since the previous report and should be read as a supplement to the two reports previously submitted. However, a few subjects could only be handled on a cumulative basis and these include information from the beginning. The major effort during this period has been marketing. This report deals at some length with that subject. Other critical areas, staff, service, and physical plant have received adequate attention but have not required the continuous action that a dynamic sales effort seems to demand. The requirement for financial independence at the Regional Dissemination Center level has put a premium on good marketing practices. Author

N68-10199# Office of Aerospace Research, Washington, D. C.
AFOSR RESEARCH: THE CURRENT RESEARCH PROGRAM, AND A SUMMARY OF RESEARCH ACCOMPLISHMENTS
Dan Taylor 1967 229 p refs
(AFOSR-67-0300; AD-659366)

The organization, program and research accomplishments of the Air Force Office of Scientific Research, a unit of the Office of Aerospace Research, USAF, are described. Emphasis is placed upon the role of AFOSR in procuring and managing a program of basic research in the sciences, carried out at university, industrial and non-profit research organizations worldwide, in response to current and long range Air Force technological interests and requirements. The research program is presented to enable Air Force user organizations and DOD research administrators and managers to gain immediate access to on-going research of direct and related interest, and to gain more detailed understanding of all AFOSR activities, and particularly those designed to couple research and research applications. Author (TAB)

N68-10230# Centre National de la Recherche Scientifique, Paris (France).
SPACE LAW [LE DROIT DE L'ESPACE]
1967 173 p refs In FRENCH; ENGLISH summary *Its* Anal. and Inform. Bull. No. 1
CFSTI: HC $3.00/MF $0.65

This bibliography on space law reviews terminology, special problems, history, relationship with other branches of law, regulations of space activities, sources, documentation and education. It also covers the legal status (sovereignty, control of spacecraft, and personnel) and questions of damage liability and restitution, pollution, intellectual property, military applications and disarmament, telecommunications applications, national problems and management, private enterprises, international organizations and cooperation, and congresses and symposia. ESRO

N68-10253# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTITANK ROCKET MISSILES
B. I. Yevdokimov 13 Apr. 1967 93 p refs Transl. into ENGLISH of the book "Protivotankovoye Reactivnoye Oruzhiye" Moscow, Min. Oborony SSR, 1964 p 1–94
(FTD-MT-65-224; AD-655039)

A popular treatment of the problems of design and combat application of antitank guided missiles (ATGM) is presented. It relates the reasons that prompted the development of these missiles and the classification of ATGMs according to the most important criteria. After an acquaintance with the general concept of an ATGM, a more detailed account is given of the basic principles of designing the individual components of the ATGM (rocket engines, airframes, and so forth). For an understanding of the principles of action of the individual ATGM components, brief information is given from aerodynamics, the theory of gyroscopes, and electronics. The pamphlet discusses the methods of firing antitank guided missiles and the procedures of firing instruction. Problems concerning the combat application of ATGM for various types of troops and for the most important forms of combat are outlined. Brief performance characteristics of contemporary ATGMs are given and the means for their further development are discussed. Futhermore, a brief description of contemporary unguided antitank rocket weapons is presented. Author

N68-10350# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBATING LOW-FLYING TARGETS
V. A. Zalepa 26 Apr. 1967 56 p refs Transl. into ENGLISH of the book "Bor'ba s Nizkoletyashchimi Tselyami" Moscow, Min. Oborony SSSR, 1966 p 1–64
(FTD-MT-66-169; AD-658250)

The peculiarities of combat with low-flying targets are cited, and certain questions regarding the construction of antiaircraft defense in United States are considered. Basic characteristics of means of attacking from low altitudes, certain types of antiaircraft guided missiles for combating low-flying targets, and methods for their combat use as well as a short characteristic of control systems of the subdivisions of antiaircraft guided missiles are discussed. Author

N68-10403*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
METHODS OF ANALYZING THE IMPACT OF PROGRAM STRETCHOUTS
William Rudelius (Minnesota Univ.) Nov. 1967 38 p refs
(NASA-TM-X-60600; MSC-BA-MR-67-4) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Delays in programs that involve the procurement of major aerospace systems are analyzed by using the elements of most of the methods observed in actual stretchout negotiations. This method involves summing the incremental costs that the stretchout contributes to each task or work package in the program. This detailed analysis often shows that some work packages are totally unaffected by the stretchout. It is recommended that NASA establish more explicit guidelines for fixing responsibility for stretchout cost additions; and that, in addition to an incremental cost analysis of tasks, NASA should develop contract clauses that permit postponement of scheduled deliveries under a predetermined cost arrangement and that reward a contractor for utilizing personnel that are temporarily surplus because of the stretched-out program. When the delivery date of one program influences subsequent delivery dates, NASA should use incentive alternatives other than the currently used reincentivizing approaches. M.W.R.

N68-10443# Battelle Northwest, Richland, Wash. Pacific Northwest Lab.
CURRENT RESEARCH ON AEROSOLS AT PACIFIC NORTHWEST LABORATORY
A. K. Postma and L. C. Schwendiman 10 May 1967 11 p Presented at the 60th Ann. Meeting of the Air Pollution Control Assoc., Cleveland, 11–16 Jun. 1967 Submitted for publication
(Contract AT(45-1)-1830)
(BNWL-SA-1255; CONF-670609-1) CFSTI: HC $3.00/MF $0.65

Abstracts describing topics of current research directly related to aerosols are presented. Topics include air cleaning, air sampling, particle inhalation, toxicity, and other areas related to control of airborne contaminants in the environment. NSA

N68-10585# Aerospace Corp., El Segundo, Calif.
USE OF AN EMPIRICAL PRODUCT-ORIENTED COST DATA BANK FOR PREDICTING AND NEGOTIATING FUTURE SATELLITE SYSTEM COSTS
Hyman Silver Jun. 1967 29 p
(Contract AF 04(695)-1001)
(TR-1001(2573-34)-1; SSD-TR-67-150; AD-659329)

This report outlines and analyzes one approach toward solving the generalized problem of poor cost estimating procedures within the aerospace industry. This approach deals with the replacement of the traditional functional system of estimating, negotiating and reporting costs with the product or end item oriented technique. Specifically, the military Comsat IDCSP program end item cost system is described, and the manner by which it was used to form a comprehensive cost data bank and the subsequent usage of the data bank to estimate new program costs are analyzed. It also describes the benefits accruing to the understanding of both parties in negotiating contract costs that have been estimated on a detailed product oriented basis. The actual re-estimating procedures that were utilized on a current Comsat program are described in detail. Author (TAB)

N68-10607# Universidad Nacional de Trujillo (Peru). Facultad de Letras y Educacion.
A COMPARATIVE STUDY OF YNGVE'S DEPTH HYPOTHESIS Final Report
Ernesto Zierer, Kisang Lee, and Anibal Sanchez May 1967 86 p refs
(Grant AF-AFOSR-1089-66)
(AROSR-67-1542; AD-659441)

The raport gives the results obtained in comparing English, German, Spanish and Japanese in the light of Yngves Depth Hypothesis. Sixty-eight different language patterns distributed over 111 different sentences in these languages and a scientific text were analyzed for their maximum depth and their depth load. The findings were the following: (a) There is a limit to regressive expansion in each of the languages analyzed. (b) Japanese stands distinctively apart from the three Indo-European languages, having a considerably greater depth. (c) The specific syntactic devices responsible for greater depth in Japanese are given. (d) The concept of depth load proved to be a criterion for further differentiation of the syntax of the four languages. (e) Regressive structures often reflect a collectivistic mentality versus an individualistic one as expressed in progressive structures. (f) The syntactic devices producing structures of greater depth are a major problem for the learner, which must be mastered by special drills graded according to increasing depth. Author (TAB)

N68-10670* Wayne State Univ., Detroit, Mich. Div. of Urban Extension.
[A PROGRAM TO ACCELERATE THE INDUSTRIAL APPLICATION TO AEROSPACE RELATED TECHNOLOGY] Final Report, 1 Jul.–31 Dec. 1966
31 Dec. 1966 247 p
(Contract NASr-175)
(NASA-CR-89992) CFSTI: $3.00 CSCL 05B

Two experimental programs were initiated for the transfer of aerospace related technology to industry: one with Chemical Abstracts Service and the other with the Small Business Administration. A list of clients is given. A cost analysis of search procedures for Chemical Titles is presented. Search lists for the Information Services Division of the SBA, giving company code, document number, data received code, date mailed code, and number of pages, are given. Minutes of meetings of the Industrial Advisory Board and of the University Advisory Committee are also given. L.S.

N68-10773 Joint Publications Research Service, Washington, D. C.
SCIENTIFIC-TECHNICAL DEVELOPMENT AND PRINCIPLES OF LONG-TERM PLANNING
Ladislav Riha 16 Nov. 1967 17 p Transl. into ENGLISH from Nova Mysl. (Prague), no. 2, Feb. 1967 p 3–7
(JPRS-43352; TT-67-33976) CFSTI: $3.00

The development of long-term socio-economic and technical–economic studies is discussed in relation to the basic concept of satisfying the needs of society with maximum efficiency and application of the law of time economy. The overall resources and basic factors of economic growth are realistically evaluated, and the basic alternatives of the structural economic development of a given country are considered from the viewpoint of the trends of scientific–technical progress and expected changes in the world economy and in the national economy. A study outline is proposed to show the direction in which the forces and the attention of the society should be oriented, and the sequence in which they should be applied to accelerate to the maximum degree the rate of speed of the socio-economic development to meet the needs of the entire society and of each individual. M.G.J.

N68-10775*# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA'S PROPOSED OPERATING PLAN FOR FISCAL YEAR 1968
Washington GPO 1967 43 p Hearing before Comm. on Aeron. and Space Sci., 90th Congr., 1st Sess., 8 Nov. 1967 CSCL 05A

The basic factors underlying the NASA operating plan are discussed in relation to the reduced budget appropriation, and the primary emphasis which will be placed on the completion of the Apollo program. Details are also given on the proposed research and development, facilities construction, and administrative operations. Testimony covered various facets of the future requirements for large vehicles, planetary exploration, nuclear rocket flight-qualified engines, large solid rocket motor development, and the Mariner and Voyager missions. Russian space activities are reviewed. M.G.J.

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